TM 11-978

WAR DEPARTMENT TECHNICAL MANUAL

MOTOR GENERATOR PU-20/C

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TM 11-978, Motor Generator PU-20/C, is published for the information and guidance of all concerned.

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For explanation of symbols see FM 21-6.

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DESTRUCTION NOTICE

WHY — To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN — When ordered by your commander.

HOW — 1. Smash — Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut — Use axes, handaxes, machetes.

3. Burn — Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives — Use firearms, grenades, TNT.

5. Disposal — Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT — 1. Smash — All castings.

2. Cut — All cables and wires.

3. Burn — Instruction manual, all papers pertaining to the operation of the unit.

4. Bend — Control box and panel.

5. Bury or scatter—Any or all pieces mentioned above after breaking.

DESTROY EVERYTHING

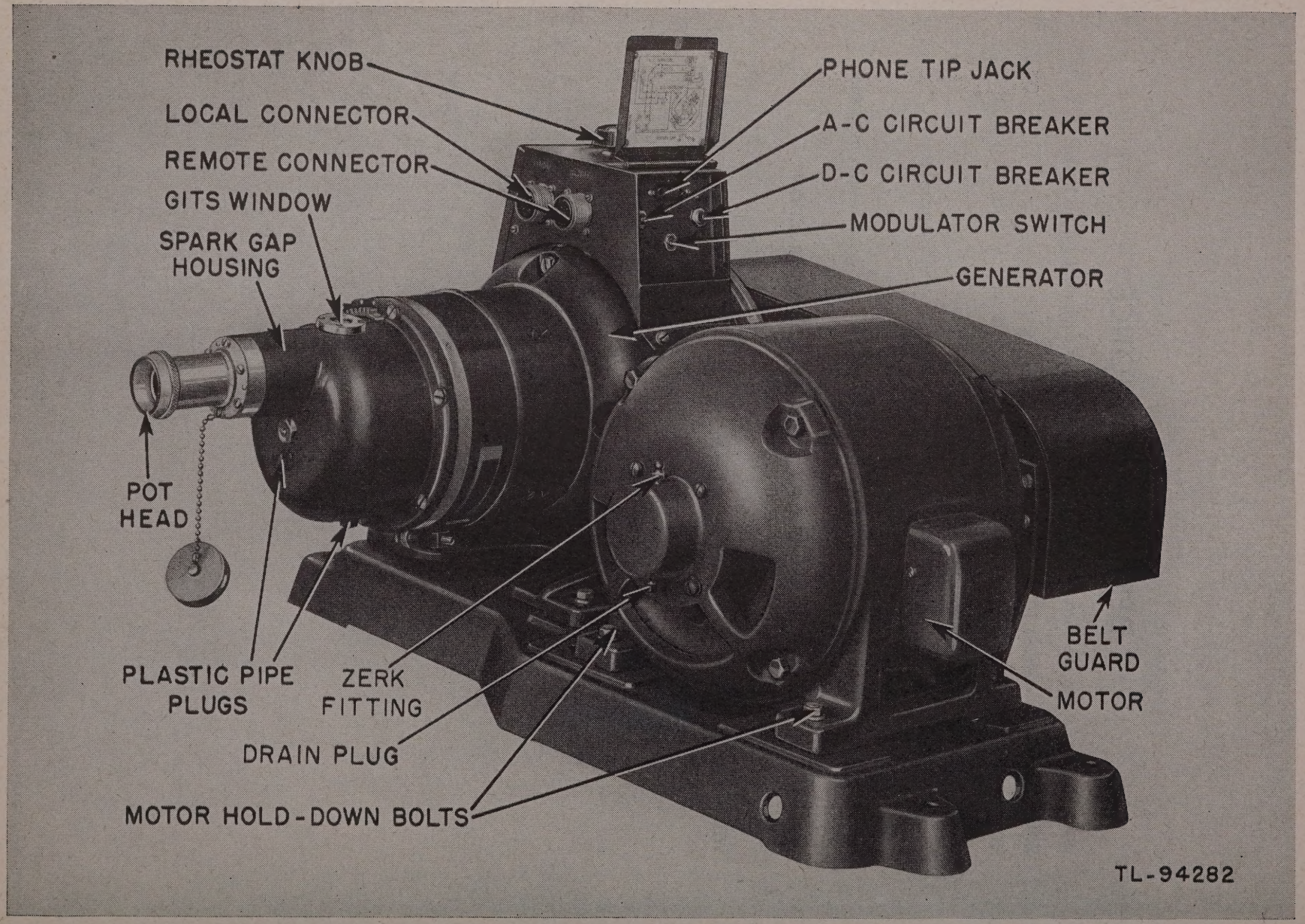

Figure 1. Motor Generator PU-20/C.

SECTION I

DESCRIPTION

1. MOTOR GENERATOR PU-20/C (fig. 1).

a. Motor. The motive power for this unit is a 3-horsepower, 1,800-revolution per minute (rpm), 115/230-volt, single-phase, 60-cycle electric motor.

b. Generator. The generator assembly consists of a 1,400-watt, 120-volt, 400-cycle inductor-alternator, and a 400-watt, 27-volt, direct-current (d-c) generator. The alternator rotor and the d-c generator armature are mounted on a common shaft which is dual-belt-driven by the electric motor. The alternator stator is mounted in a shell which is fastened to the fan housing. The d-c yoke, field-coil assembly, and brush head are fastened to this shell. A spark-wheel assembly is mounted on the end of the armature shaft. A spark-gap housing with pothead incloses the spark wheel.

c. Control Box. A weatherproof output box is mounted on the top of the stator shell. It contains a rheostat, adjustable resistor, two pin jacks for plugging in an alternating-current (a-c) voltmeter, one LOCAL and one REMOTE connector (receptacle) for plug-in power connections, one a-c circuit breaker, and one d-c circuit breaker. A double-pole, single-throw toggle switch is installed in the d-c circuit of the LOCAL connector (receptacle).

d. Tools and Spare Parts. A cloth bag containing the following tools and spare parts is shipped with each power unit:

Spare Parts	*Tools*
8 generator brushes (165)	1 wrench, 7/16 inch box and open end
2 capacitators (166-1)	1 wrench, 11/16 inch by 9/16 inch open end
4 V-belts (133)	1 screwdriver, 8 inch
	1 wrench, short, for 5/16 inch socket setscrew
	1 crocus cloth sheet

2. DIMENSIONS.

Motor Generator PU-20/C is 28 inches wide, 33 inches long, and 18 inches high, and weighs 285 pounds.

SECTION II

INSTALLATION AND OPERATION

3. INSTALLATION.

a. Motor Generator PU-20/C is fastened to the base of a wooden case. This base must be removed before the unit is set up for operation. Construct a level wooden or concrete base. Bolt the unit to the base securely, using suitable bolts. Connect the electric power line to the motor. Follow wiring instructions as indicated on the motor. Check the tension of the V-belts before operation. Placing light pressure on the belts should cause a deflection of approximately 1/2 inch (par. 14).

b. A spark-gap housing (fig. 1) incloses the spark wheel which has six equally spaced collet screws (fig. 5). Different modulator circuits require three or six electrodes on the spark wheel. Units are shipped with three equally spaced installed electrodes. Three additional electrodes are in the spare parts bag. Before the unit is placed in operation, turn pulley slowly by hand. Check the number of electrodes installed on the spark wheel by looking through the gits window. *The number of electrodes must be correct for the particular modulator circuit used.* Change the number of electrodes if necessary (par. 17).

4. OPERATION.

a. General. Remove the two plastic pipe plugs (fig. 1) inserted in the back and bottom of the spark-gap housing before the unit is operated. These plugs are used to seal the housing from dirt and moisture during shipment.

b. Connections for Operation (fig. 1). (1) Plug the low-voltage cable of the using equipment into the LOCAL connector. Connect the short high-voltage cable to the pothead (fig. 1) on the end of the generator. Plug the other cable from the equipment into the REMOTE connector.

(2) Make sure the modulator switch on the control panel is OFF before the unit is started. *Do not turn to ON* until the motor generator has been in operation for *at least 30 seconds.*

(3) Check the voltage (under load) of the a-c output by plugging the voltmeter leads into the phone tip jack located on the control panel. The voltage is regulated by turning the rheostat knob on top of the control box.

5. PREPARATION FOR STORAGE.

a. Extended Storage. (1) Clean all external surfaces of the motor generator.

(2) Paint all spots where the original paint is off or brush on a coating of rust-preventive compound. Thin film rust-preventive compound (CT) applied cold or light rust-preventive compound (CL) applied hot is satisfactory for coating external surfaces.

(3) Seal openings with greaseproof paper and tape. For this purpose, use Paper, Wrapping, Greaseproof, Spec No. AXS-840, and Tape, Adhesive, Non-hygroscopic, Spec No. AXS-871.

(4) Attach a tag to the unit stating that it has been prepared for storage, and the date it was treated.

(5) Use only dry-cleaning solvent (SD), or Diesel fuel oil for cleaning fluid.

b. Stand-by Storage. Follow the procedure described in subparagraph *a* above. If the unit is stored for a short time, and is not to be kept in an extremely humid atmosphere, it will not be necessary to seal openings.

SECTION III

FUNCTIONING OF PARTS

6. MOTOR.

The motive power for Motor Generator PU-20/C is a conventional, 115/230-volt, single-phase, 60-cycle, 1,800-rpm electric motor.

7. GENERATOR.

a. D-c Generator and Exciter. A compound-wound, four-pole, d-c generator supplies 400 watts of useful output at 27-volt dc. It also excites the field of the 400-cycle alternator. No manual control of the useful output voltage of this generator is used.

b. Alternator, 400-cycle. This is a 400-cycle, inductor-type generator having its excitation winding and output winding both on the stator. The rotor has six equally spaced metal projections which cause the flux through the stator teeth to pulsate and thus generate voltage. The field rheostat, controlling the current from the d-c generator (exciter), is used to control the output voltage of this alternator.

8. CONTROL BOX.

The function of the control box is to provide an easy, accessible means for controlling and regulating the output of the motor generator. The rheostat is used to control the amount of current being fed from the d-c generator to the field (rotor) of the alternator, thus increasing or decreasing the a-c output voltage. A-c and d-c circuit breakers are used to open the respective circuits in the event of an overload. No fuses are used. Pin jacks are connected across the a-c line to provide access for the reading of the voltage and frequency with suitable instruments. An ordinary a-c voltmeter (for 60 cycles) should not be used to read the voltage. Procure a voltmeter designed for 400-cycle operation.

SECTION IV

MAINTENANCE

NOTE: Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on W.D., A.G.O. Form No. 468 (Unsatisfactory Equipment Report). If Form No. 468 is not available, see TM 38-250. Failure or unsatisfactory performance of equipment used by Army Air Forces will be reported on Army Air Forces Form No. 54 (unsatisfactory report).

9. REASON FOR PREVENTIVE MAINTENANCE.

The man-hours spent in performing preventive maintenance are few compared with the man-hours spent in repairing broken-down equipment. Maintenance required by Motor Generator PU-20/C is limited for the most part to lubrication and cleaning. These two operations, if performed at suitable intervals, will prolong the life of the unit and minimize equipment failures.

10. OUTLINE OF PREVENTIVE MAINTENANCE AND REPAIR.

a. Maintenance. Paragraph 11 lists the U. S. Army approved lubricants which are used for all lubricating, cleaning, and rust-preventive work done on Motor Generator PU-20/C. Paragraphs 12 to 17 inclusive describe the procedures to follow for maintaining the motor generator. Paragraph 18 lists maintenance operations and their time intervals between applications. References to appropriate paragraphs may be used to help locate more detailed information.

b. Repair. Paragraphs 20 to 23 inclusive contain trouble-shooting charts and repair procedures. The necessary disassembly and assembly steps are outlined in their natural sequence of operations. Appropriate illustrations are given to facilitate the understanding of the more complex instructions. Break-downs should be few because the equipment is simple in construction and rugged in design. Before attempting trouble shooting or disassembly of the unit, check the generator load for defects which may reflect upon the operation and electrical readings of the motor generator. Moistureproofing and fungiproofing procedures are described in paragraph 19.

11. RECOMMENDED LUBRICANTS.

The following table lists the lubricating material necessary in servicing the equipment:

Approved symbol	Standard nomenclature	Specification No.
WB2	Grease, General Purpose No. 2	U. S. Army 2-108
SD	Solvent, Dry Cleaning	Federal P-S-661a
DA or DX	Oil, Fuel, Diesel for High Speed Automotive Type Diesel Engines	U. S. Army 2-102C
CT	Compound, Rust Preventive, Thin Film	AXS-673
CL	Compound, Rust Preventive, Light	U. S. Army 2-84 (latest revision)

12. LUBRICATION.

a. Motor. After every 512 operating hours, lubricate the motor as follows:

(1) Shut down the unit.

(2) Remove the cover over the belts.

(3) Remove the drain plugs at the bottom of both bearings (fig. 1).

(4) Apply general purpose grease (WB2) through the Zerk fittings, using the supplied grease gun, until grease appears at the drain hole.

(5) Expel excess grease by running the motor until operating temperature is reached.

(6) Replace the drain plugs.

(7) Using a dry, clean cloth and dry-cleaning solvent (SD), if necessary, wipe dirt and excess grease from the motor housing.

b. Generator. No lubrication is required for the sealed bearings of the alternator and exciter unit.

c. Sealed Bearings. Although sealed bearings contain sufficient lubricant to last for the life of the generator, bearing replacement may have to be made if bearing noises develop. Do not attempt to lubricate the sealed

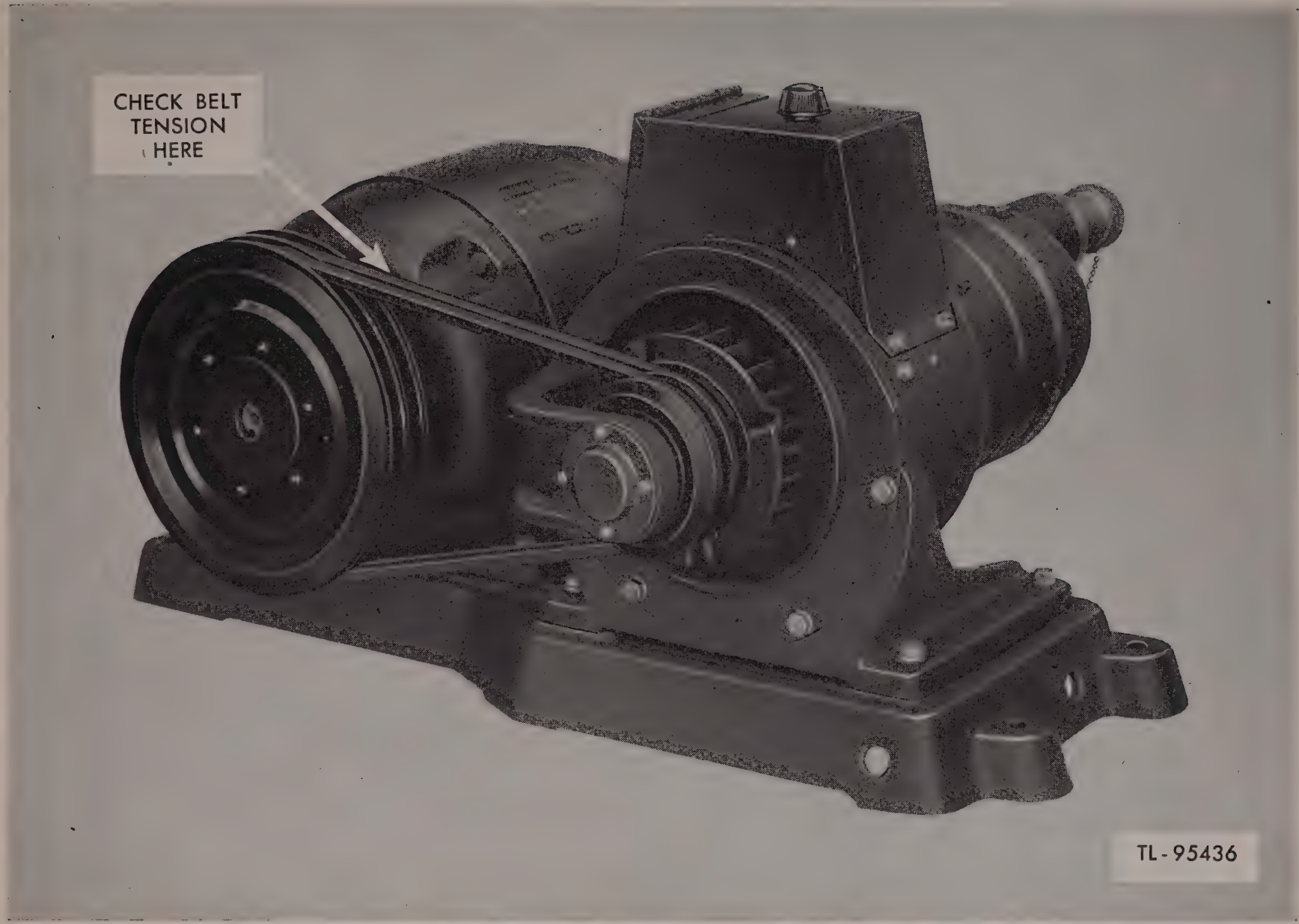

Figure 2. Motor Generator PU-20/C with belt guard removed.

bearings. When making replacements, use extreme care to keep dirt from entering the bearing surface. Keep the bearing wrapped in its original packing until ready for use. Keep the work bench and hands clean.

13. MOTOR BEARING WASHING PROCEDURE.

a. Washing Bearings. Occasionally the motor bearings should be purged of old and hardened grease. Proceed as follows:

(1) Clean the grease gun, Zerk fittings, and hands.

(2) Prepare a clean area in which to work. Abrasives which enter into the bearing area are not easily removed with solvents.

(3) Remove the Zerk fittings and drain plugs.

(4) With a fairly sharp tool of suitable size (small screwdriver), clean the plug holes of hardened grease.

(5) Fill a syringe or similar device with dry-cleaning solvent (SD) and inject a small quantity into the bearing housing through the fitting hole. As the grease becomes diluted or thinned, it will drain out through the drain hole. Continue to add the solvent until it drains clear. Run the motor during this operation (not more than a few minutes). Be careful to avoid splashing the solvent on the motor windings through the ventilating openings.

(6) After all the solvent has drained from the bearings, replace Zerk fittings and proceed with the greasing as described in paragraph 12.

b. Clean-up after Washing Bearings. After the bearings have been greased, and the drain plug replaced, wipe the entire bearing housing with a clean cloth dipped in dry-cleaning solvent (SD). Finish the job by cleaning the entire motor generator.

14. V-BELT MAINTENANCE.

Inspect the two V-belts every 64 operating hours for the proper tension. Proper tension is a degree of belt tightness, which, with moderate finger pressure exerted on the belt midway between the pulleys (fig. 2), will allow a belt depression of about 1/2 inch. If the belt is too slack, loosen the motor hold-down bolts (fig. 1) and move the motor away from the generator. Tighten the hold-down bolts and check the tension. Repeat the process until the proper tension is obtained.

CAUTION: Excessive tension will stretch the belts beyond use, and shorten bearing life.

15. D-C GENERATOR COMMUTATOR AND BRUSH ASSEMBLY.

a. Commutator. Check every 512 operating hours. The commutator surface should normally be a mahogany brown color. Do not attempt to maintain a highly polished surface. Sand the commutator only if the copper segments are rough, pitted, or extremely carbonized. Proceed as follows:

(1) Loosen the headband screw under the brush headband (fig. 3) and slide the band over to the side to expose the commutator and brush assembly.

(2) Attach a piece of canvas to a suitable piece of wood. Place the canvas on the commutator while running the generator. If the canvas cleaning does not remove the dirt, use dry-cleaning solvent (SD). If the commutator is scored, place a piece of 00 sandpaper over a piece of wood and, while the generator is running, place the sandpaper on the copper segments with a slight pressure. Move the sandpaper from side to side until the commutator is smooth and clean. Finish up with the canvas cloth on the wooden stick. If the sandpaper does not remove the grooves or scoring, the commutator may have to be turned down on a lathe.

CAUTION: Do not use emery cloth or paper on the commutator. Emery, a conductor of electricity, will short-circuit the commutator segments.

b. Brushes and Brush Assembly. Check the brushes and brush assembly every 512 operating hours. The brushes should last about 1,000 hours; however, excessive arcing will shorten their life. The four brushes in the d-c generator must make firm contact with the commutator surface to prevent arcing. The spring tension needed to make good contact is about 14 ounces. Check the tension with the finger when making routine checks. If in doubt about the proper tension, use a spring scale to measure the pull. Replace the brush when its length is reduced to the point which permits the brush spring to ride on the brush holder. If the brush holder binds the brush, remove the brush and sand that side which shows evidence of binding. Replace brush in its holder and check for further binding. The brush must fit freely in its holder.

16. SPARK WHEEL BRUSH (fig. 4).

Inspect the spark wheel grounding brush every 512 operating hours. When removing the brush from the spark wheel housing, be careful not to drop the grounding brush out of the brush holder. To do so will necessitate the removal of the entire spark wheel housing in order to retrieve the brush. Replace the brush if its length is less than 1/2 inch.

17. SPARK WHEEL ELECTRODES (fig. 5).

The electrodes will become pitted as a result of normal operation. Polishing the electrodes is not necessary if

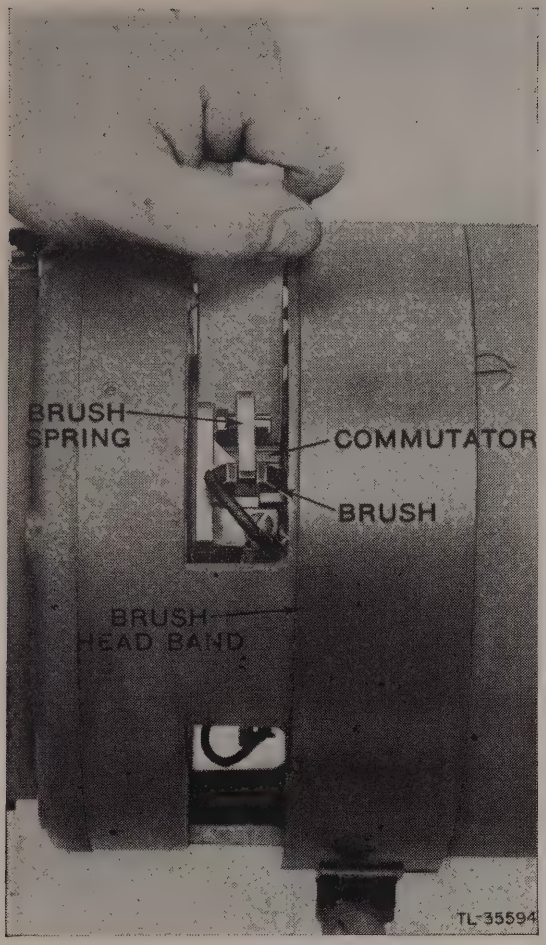

Figure 3. Cleaning commutator.

Figure 4. Inspecting grounding brush.

this occurs. Inspect electrode condition every 200 operating hours. Replace electrodes only when their length is insufficient to maintain a normal gap. To replace the electrodes, proceed as follows:

a. Stop the motor.

b. Remove the six screws which hold the clamp ring to the brush head.

c. Lift off the spark wheel housing as shown in figure 5.

d. Loosen the collet nuts on the spark wheel with a suitable wrench and pull out the electrodes.

e. Insert new electrodes. Position them so that the electrode ends are flush with the backs of the collet screws. Tighten the nuts.

f. *If three electrodes are used, they must be evenly spaced on the spark wheel.*

g. Replace the spark wheel housing. Check the position of the electrodes by looking through the gits window (peephole).

18. PREVENTIVE MAINTENANCE SCHEDULE.

The following table covers maintenance operations to be carried out on Motor Generator PU-20/C at the time intervals shown.

Job to be done	Every 8 hours	Every 64 hours	Every 200 hours	Every 512 hours	Every 1,024 hours
Clean unit	X				
V-belts inspection (par. 14)		X			
Spark wheel electrodes (par. 17)			X		
Spark wheel grounding brush (par. 16)				X	
Motor bearings, lubrication (par. 12)				X	
Generator bearings (sealed, no lubrication required)					
Commutator, d-c generator (par. 15)				X	
Brushes, d-c generator (par. 15)				X	
Motor bearings, wash (par. 13)					X

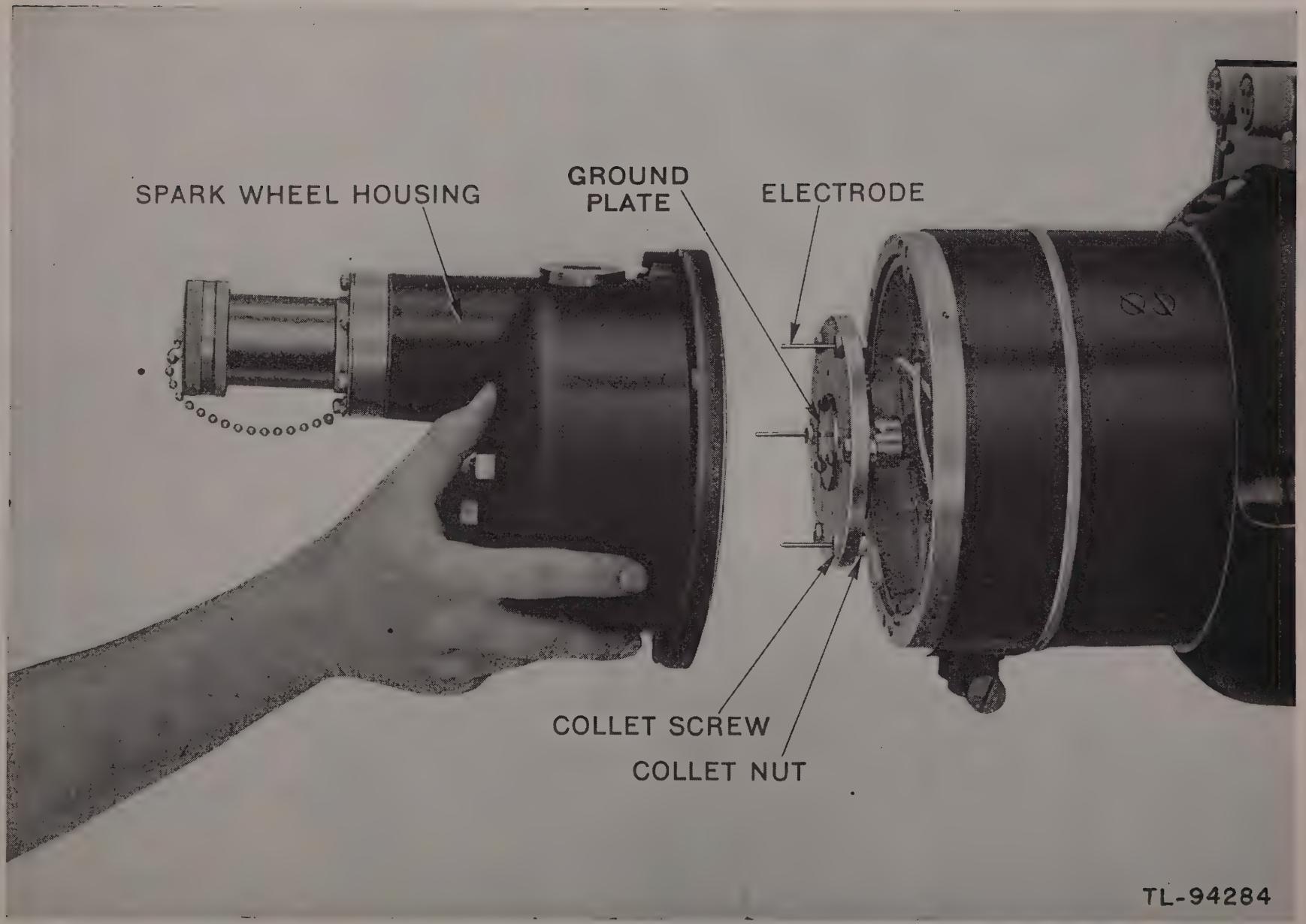

Figure 5. Inspecting electrodes.

19. MOISTUREPROOFING AND FUNGIPROOFING.

a. General. The operation of Signal Corps equipment in tropical areas, where temperature and relative humidity are extremely high, requires special attention. The following items represent problems which may be encountered in operation:

(1) Resistors, capacitors, coils, etc., fail.

(2) Electrolytic action takes place in coils, resistors, etc., causing eventual break-down.

(3) Hook-up wire and cable insulation breaks down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips.

b. Treatment. A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant lacquer applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing, and of tools and materials used.

CAUTION: Varnish spray may have toxic effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth.

c. Step-by-step Instructions for Treating Motor Generator PU-20/C.

(1) PREPARATION. Make all repairs and adjustments necessary for proper operation of the equipment.

(2) DISASSEMBLY (fig. 6). Remove the control box from the generator frame for baking and spraying. To disconnect the box, remove all the wires leading from the generator yoke as follows:

(*a*) Remove the four screws holding the control box to the generator frame and turn back the box to expose the inside.

(*b*) Remove the lead with the red marking band from the d-c circuit breaker terminal, 1.

(*c*) Remove the lead with the green marking band from the ground lug, 2, on the filter capacitor.

(*d*) Replace the remaining three leads on the capacitor ground lug and tighten the screw.

(*e*) Remove the white lead from the rheostat arm terminal, 3.

(*f*) Replace the remaining two wires on this terminal and tighten the screw.

(*g*) Remove the white lead with the black tracer from the other rheostat terminal, 4.

(*h*) Loosen slightly the locknut on the modulator switch, and rotate the body of the switch so that the white lead with the black tracer may be removed from terminal, 5.

(*i*) Replace the remaining lead on this switch terminal and tighten the screw.

(*j*) Remove the generator lead with the green marking band from the a-c circuit breaker terminal, 6. Replace the remaining lead and tighten the screw.

(*k*) Remove the control box (to be treated).

(*l*) Remove the six screws holding the spark wheel housing to the brush head (fig. 5). Lift off the spark wheel housing (to be treated).

(*m*) Remove the three screws and take off the ground plate (fig. 7).

(*n*) Remove the armature bolt with the collet washer, and back off the rear hexagonal nut on the armature shaft to remove the spark wheel (fig. 7).

(*o*) Pull the brush out of the brush holder, 9, (fig. 8) in the spark wheel housing.

(*p*) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

(3) MASKING (fig. 8). Cover the following parts with masking tape:

(*a*) The bare wire portion of the rheostat, 1.

(*b*) The contact, 2, on the rheostat arm.

(*c*) The bare wire portion, 3, of the resistor.

(*d*) The openings in the power outlet receptacles, 4.

(*e*) The terminal, 5, on the d-c circuit breaker from which the lead was removed.

(*f*) The terminal, 6, on the rheostat from which the lead was removed.

(*g*) The spark wheel electrode pins, 7, after wrapping with paper.

(*h*) The stationary electrode, 8, after wrapping with paper.

(*i*) The opening in the brush holder, 9, on the spark wheel housing.

(*j*) The shaft openings, 10, and the three holes for the grounding plate screws on the spark wheel hub.

(4) DRYING. Place equipment in oven or under heat lamps and dry for 2 to 3 hours at 160° F.

(5) VARNISHING. Spray three coats of Lacquer, Fungus-resistant, Spec No. 71-2202 (Stock No. 6G1005.3) or equal, on the following parts:

(*a*) The inside of the control box.

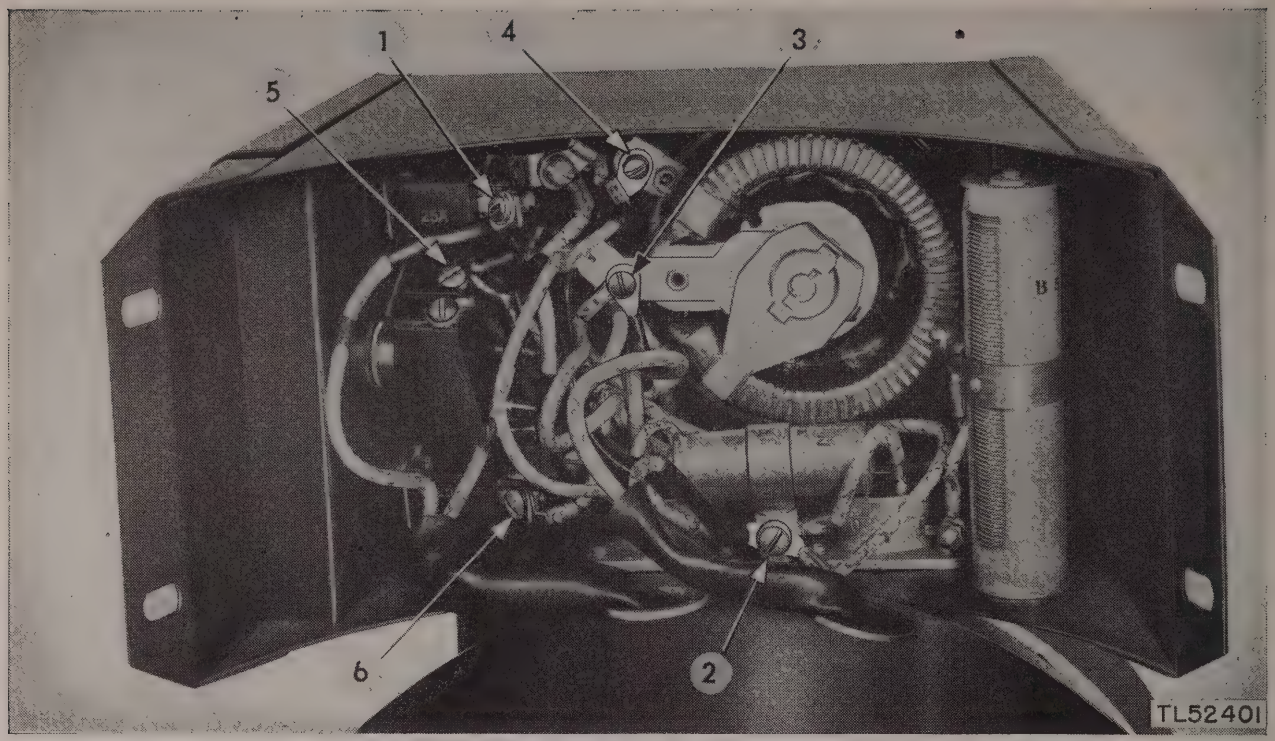

Figure 6. Removing control box.

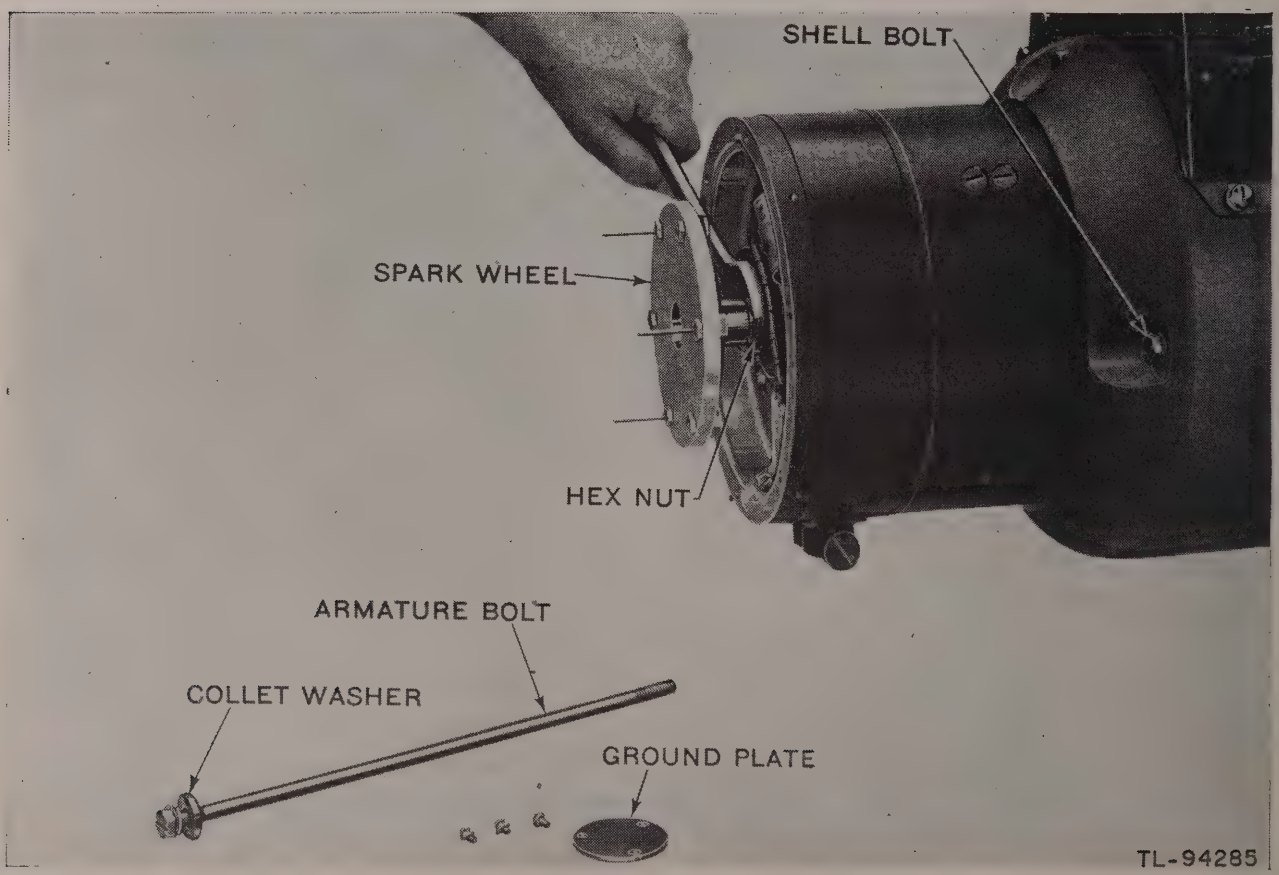

Figure 7. Removing spark wheel.

(*b*) The inside of the spark wheel housing.

(*c*) All sides of the spark wheel.

(6) REASSEMBLY.

(*a*) Remove all masking tape.

(*b*) Clean all contact surfaces with varnish remover, and burnish the contacts.

(*c*) Reassemble the motor generator and test its operation.

(7) MARKING. Mark the set with "MFP" and the date of treatment.

EXAMPLE: MFP—6 September 1944.

20. MOTOR GENERATOR TROUBLE CHART.

Trouble	*Possible Cause*
a. Motor fails to start or is not up to speed.	(1) Low voltage of power supply. (2) Failure of power supply.
b. Arcing occurs at brushes.	(1) Defective capacitor on brush head. (2) Commutator dirty or scored. (3) Worn brushes. (4) Brushes stuck in holders or reversed. (5) Broken or weak brush spring. (6) Short circuit in system. (7) Shorted field coil. (8) Open or shorted coil in armature.
c. Motor generator fails to generate current.	(1) Circuit breakers on control panel open. (2) Brushes stuck in holders or reversed. (3) Defective capacitor on brush head. (4) Worn brushes. (5) Dirty commutator. (6) Broken or loose connections. (7) Defective armature. (8) Defective rheostat or resistor. (9) Defective field coil. (10) Defective stator winding (a-c). (11) Loss of residual magnetism (d-c field).
d. Motor generator fails to deliver rated output (1,400-watt ac in addition to 400-watt dc).	(1) Motor not up to speed. (2) Dirty commutator. (3) Worn brushes. (4) Brushes not properly seated. (5) Short circuit in system. (6) Broken or weak brush spring. (7) Defective capacitor on brush head.
e. Radio reception is noisy.	(1) Defective capacitor on brush head. (2) Loose connections. (3) Excessively dirty commutator. (4) Arcing at brushes. (5) Defective capacitor in control box. (6) Internal-external lockwashers not used on screws in the following places: (a) Secure capacitor in brush head. (b) Secure capacitor in control box (two external lockwashers used).

21. DISASSEMBLY OF MOTOR GENERATOR.

CAUTION: Internal-external-tooth lockwashers must be reinstalled on all screws exactly as removed to prevent radio interference. See paragraph 20*e* for location of these lockwashers.

a. Removing Spark Wheel Housing (fig. 5). Take out the six screws in the clamp ring, holding the spark wheel housing to the brush head. Then remove the complete housing.

b. Disassembling Generator. (1) Remove the ground plate by taking out the three screws.

(2) Remove the armature bolt with collet washer, and back off the rear hexagonal nut on the armature shaft to remove the spark wheel (fig. 7). Remove the brush headband and lift the four brushes out of their holders.

(3) Remove the four shell bolts (fig. 7), insert a large screwdriver in the notch on the side of the shell, and pry off the complete generator assembly (fig. 9). The armature shaft is keyed on the countershaft. To remove it, pry with a wooden bar placed between the generator mounting bracket and the a-c rotor (fig. 10). Remove the key from the countershaft.

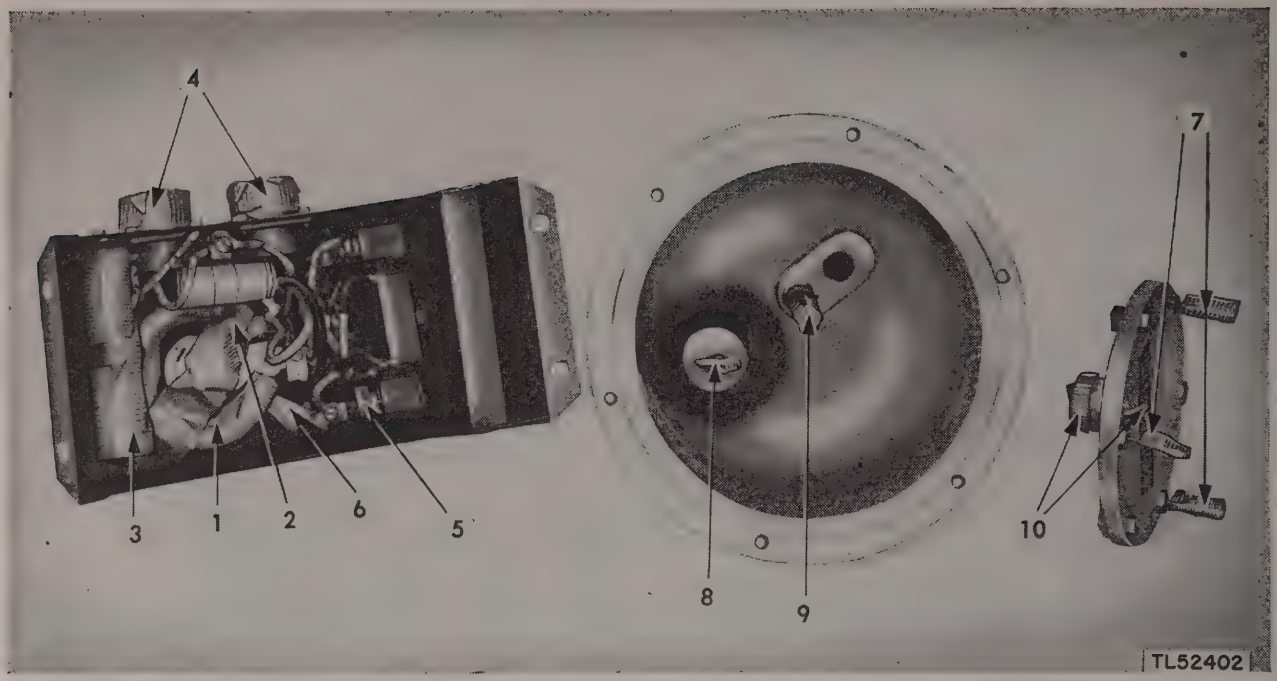

Figure 8. Generator parts masked for spraying.

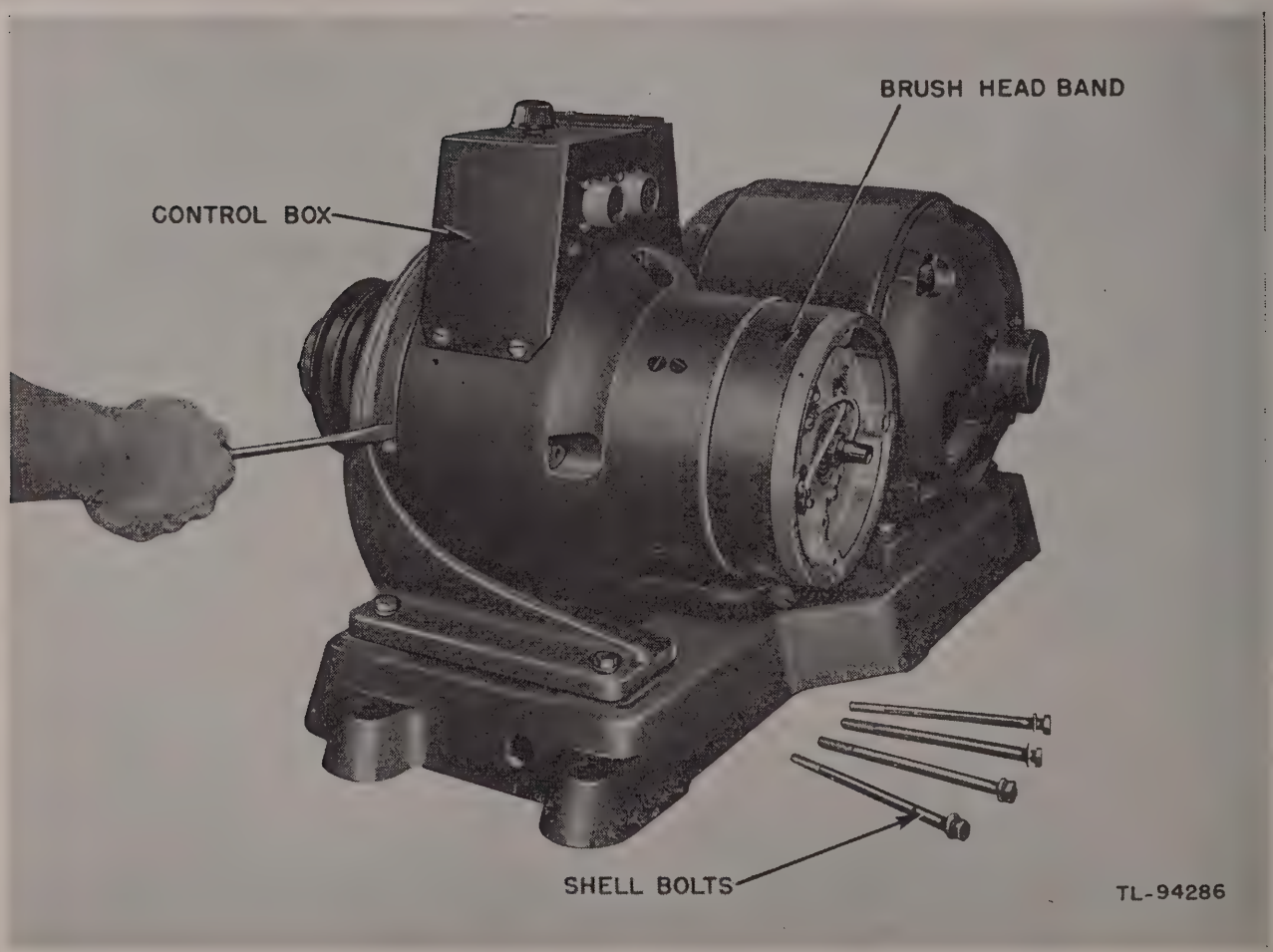

Figure 9. Removing generator assembly.

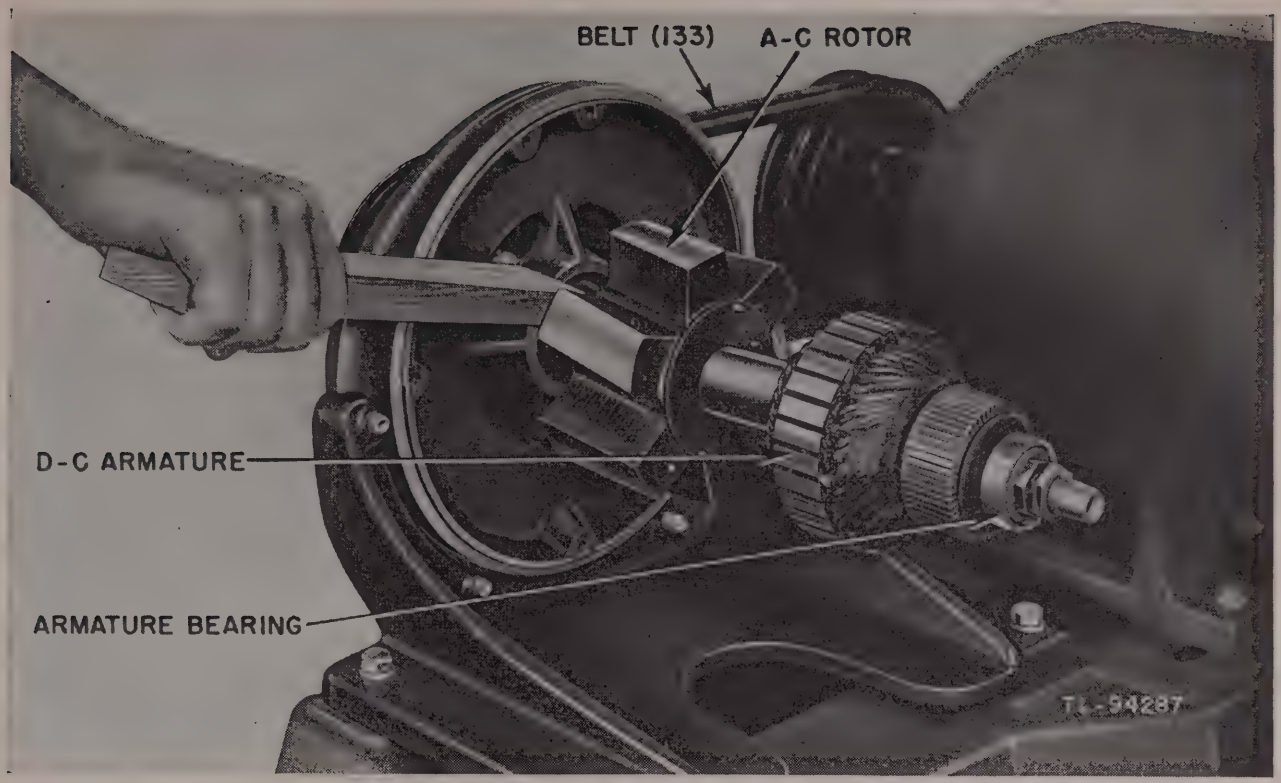

Figure 10. Removing armature assembly.

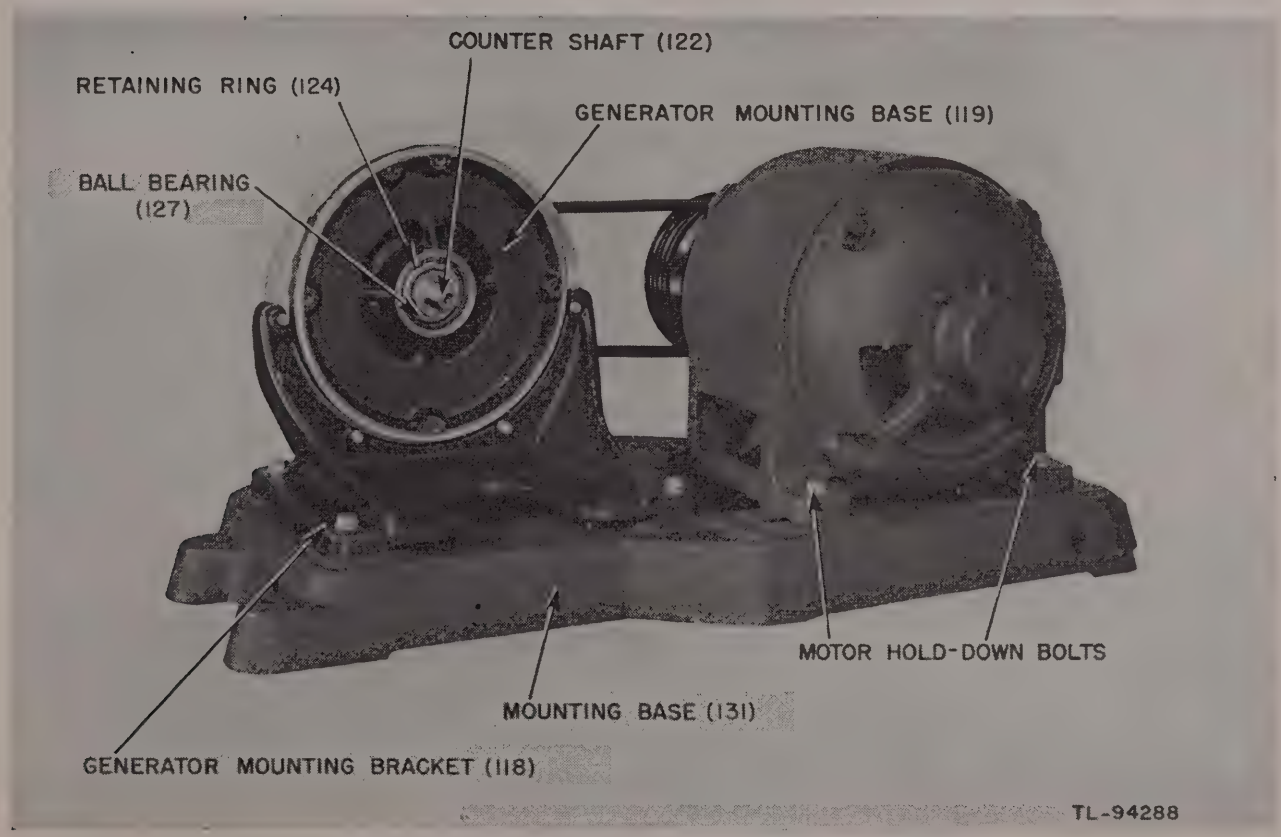

Figure 11. Mounting with generator and belt guard removed.

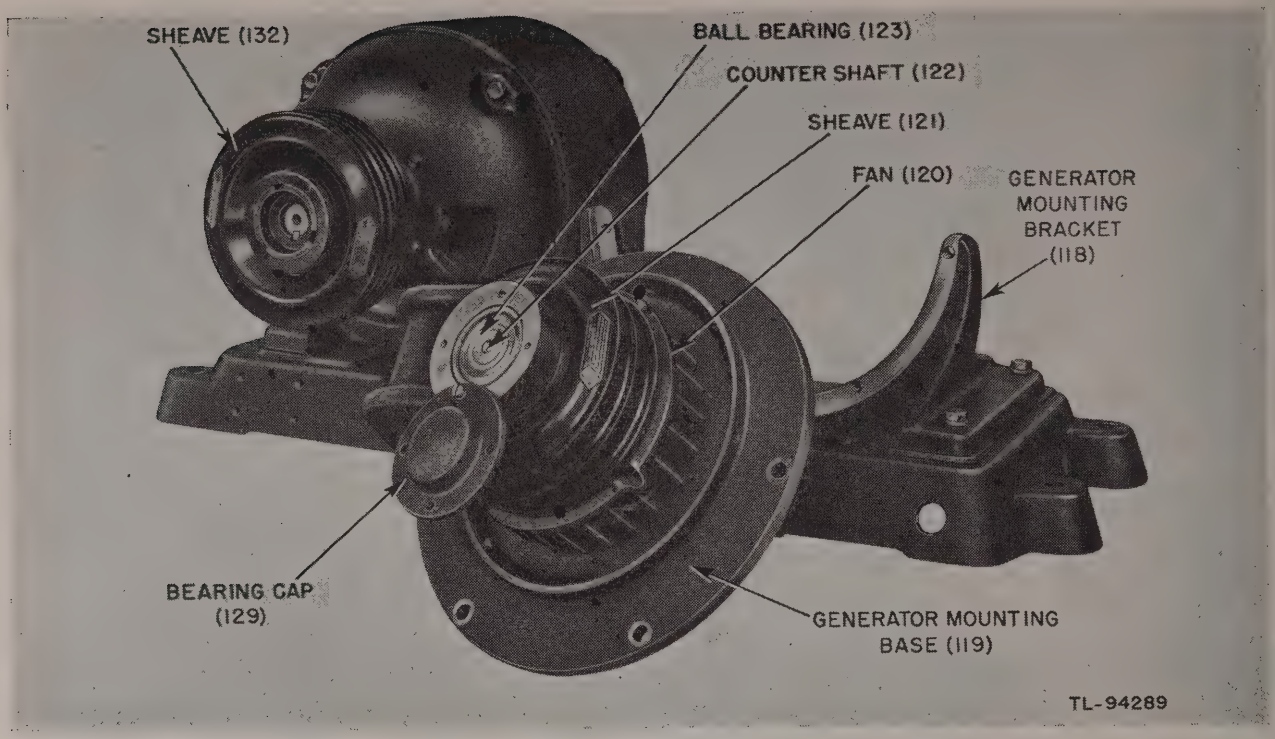

Figure 12. Generator mounting base assembly removed from bracket.

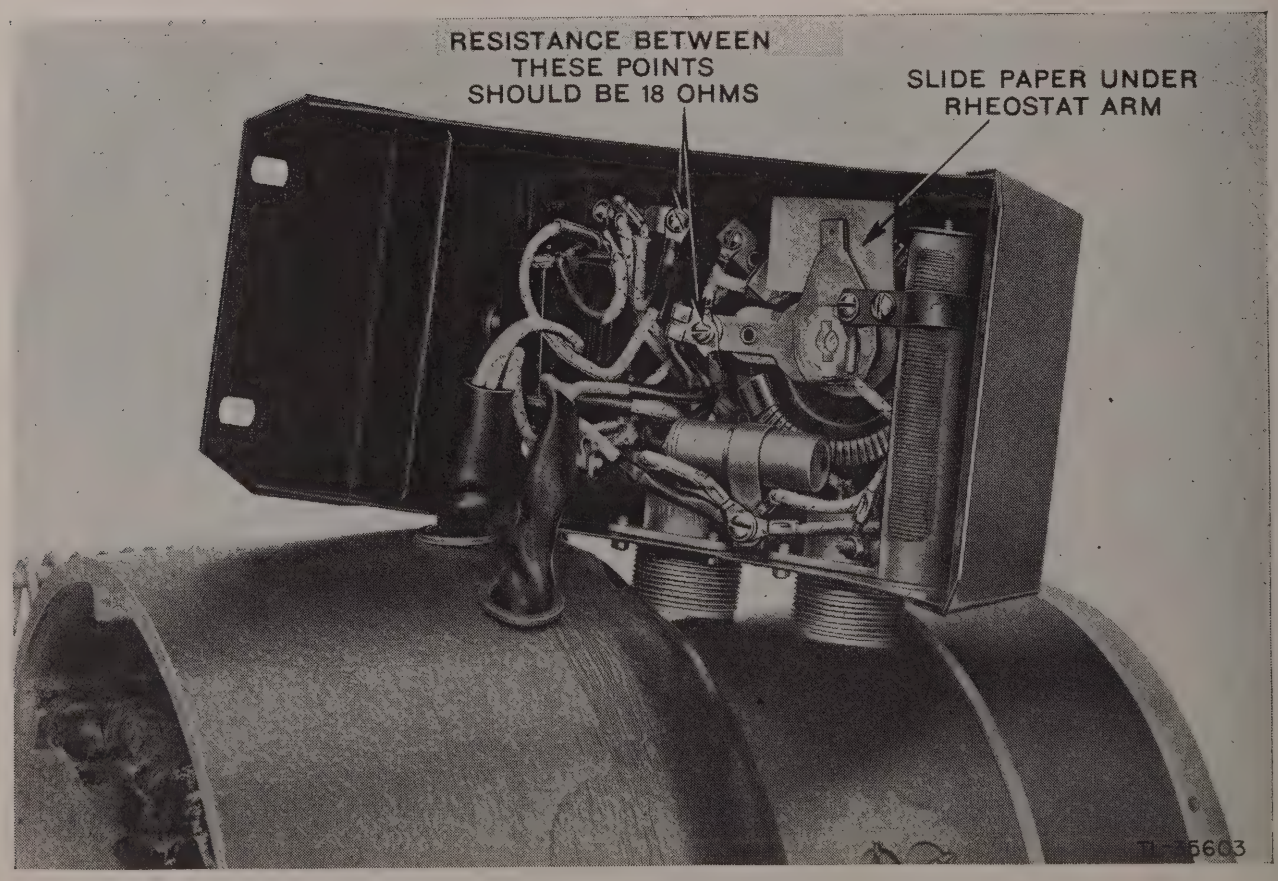

Figure 13. Points for testing shunt winding of d-c field.

c. Disassembling Generator Mounting. (1) Remove the three No. 10-32 screws holding the belt guard to the generator mounting base (fig. 1).

(2) Remove the two 3/8-inch hexagonal screws holding the belt guard bracket to the mounting base. Lift off the belt guard.

(3) Loosen the four bolts holding the motor to the mounting base and slide the motor toward the generator. Remove the two V-belts from the sheaves (fig. 12 (132)).

(4) Remove the retaining ring (fig. 11 (124)) from behind the bearing on the alternator end of the countershaft.

(5) Remove the four 3/8-inch hexagonal screws holding the generator mounting base to the generator mounting bracket, and remove the base with all parts attached (fig. 12).

(6) Remove the bearing cap (fig. 12 (129)) by taking out the four No. 10-32 screws.

(7) Remove the two socket setscrews from both the sheave (fig. 12 (121)) and the fan (fig. 12 (120)).

(8) Tap on the end of the countershaft (fig. 12 (122)) which was covered by the bearing cap (fig. 12 (129)) until it is driven through all parts. The front bearing will remain in the generator mounting base, and the rear bearing will remain on the countershaft.

(9) The generator mounting bracket or the motor may now be removed from the base by removing the four screws holding each. The sheave (fig. 12 (132)) on the motor and the sheave (fig. 12 (121)) on the countershaft are attached to their shafts with setscrews.

22. GENERATOR TESTING (A-C AND D-C).

a. Generator Tests. (1) PRELIMINARY TESTS. Make the following tests with the stator and yoke assembled, the armature removed or the brushes lifted from commutator, and all wires connected.

(*a*) Remove the four screws holding the control box to the shell. Turn back the box to expose the inside. Do not disconnect any wires.

(*b*) Slide a piece of paper under the rheostat arm (fig. 13) to insulate it from the winding. Connect an ohmmeter between the positive lead of the d-c circuit breaker and the center arm of the rheostat. The normal reading of approximately 18 ohms is the resistance of the shunt winding of the d-c generator field. Remove the paper after this test.

(*c*) Connect an ohmmeter between the right-hand top brush holder and the C terminal of the REMOTE receptacle. The resistance should be less than 1 ohm. This tests the continuity of the series winding of the d-c field.

(*d*) Place the ohmmeter prods between the A and B terminal of either REMOTE or LOCAL receptacle. Reading should be less than 1 ohm. The B terminal of both receptacles is grounded to the control box.

(*e*) Turn the rheostat completely clockwise, and throw the modulator switch to ON. Connect the ohmmeter between the D terminals of the REMOTE and LOCAL receptacles. Normal reading of the alternator field winding is approximately 5 ohms.

(2) INDIVIDUAL TESTING. If the readings in subparagraph (1) above are not normal, check all connections. Then proceed to test the individual parts:

(*a*) *Rheostat.* Resistance, when fully cut-in, is 10 ohms.

(*b*) *Resistor.* The maximum resistance of the variable resistor is 5 ohms.

(*c*) *Circuit Breakers.* Check for open circuit with ohmmeter.

(*d*) *D-c Field.* The small wires coming from the shell are the shunt winding leads. The resistance for all four coils is approximately 16 ohms. The resistance of the individual field coil is approximately 4 ohms at room temperature (24° C). The larger diameter wires are the series field winding leads. Resistance for all four coils, or for one coil, should be almost zero. If the field coils are removed, be sure to mark the pole piece so that they may be replaced in original location and exact position.

(*e*) *Alternator.*

1. A-C WINDING. The green-coded wires coming from the stator shell are the a-c winding leads. Resistance between them should be 0.125 ohm at 24° C.

2. FIELD WINDING. The black-coded wires coming from the stator shell are the field winding leads. The resistance between them should be approximately 4 ohms at 24° C.

(*f*) *Spark Wheel.* Examine the spark wheel for burned electrodes (par. 7).

(*g*) *Armature (d-c).*

1. SHORT CIRCUIT. Test by use of a growler.

2. OPEN CIRCUIT. Hook up four 6-volt storage batteries in series. Insert a 10-ohm rheostat (150 watt) in series with one side of the 24-volt line. Place the arm of the rheostat at the center of its travel (about the midpoint of the resistance winding). About 5 amperes should flow through the above described circuit if the battery voltage is 24 volts and the test prods are short-circuited. Now apply the test prods to clean surfaces on adjacent segments of the commutator, and adjust the rheostat arm slightly clockwise or counterclockwise until the ammeter (if used) reads 5 amperes. If no ammeter is available, keep the rheostat arm at the center of its travel. Keep the shaft of the armature in a horizontal position. Place a compass 1/16 inch above armature core. The compass needle will

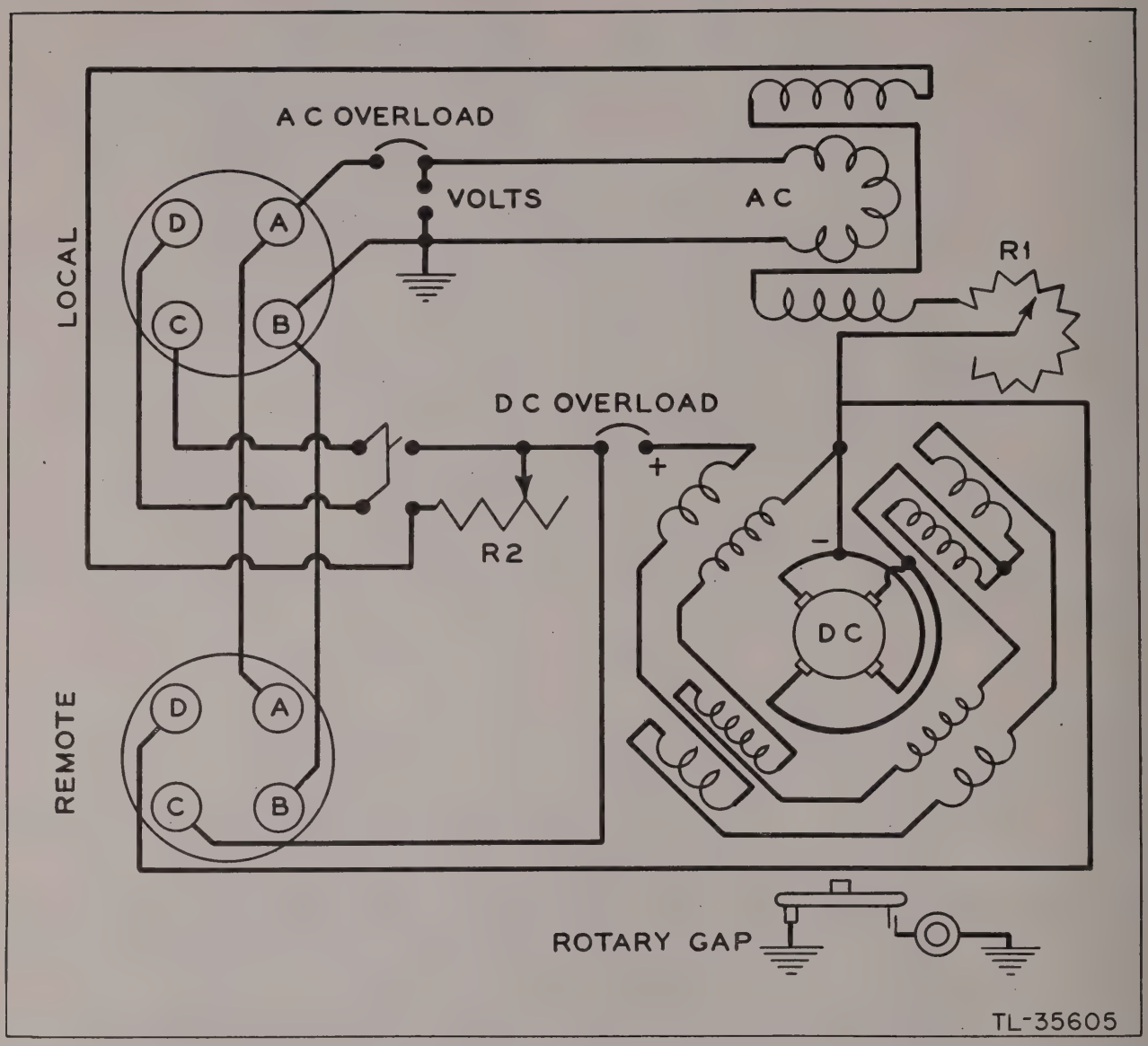

Figure 14. Schematic wiring diagram.

pull down if the winding is continuous. No deflection of the needle indicates an open circuit. This test must be made on every commutator segment.

3. Ground Tests. Apply 500 volts between the core or shaft, and a commutator segment. These are normally insulated from each other. An indicating device of some kind should be in series with the 500-volt line to indicate passage of current (if a short circuit exists). If high voltage is not available, screw a 75- or 100-watt bulb in a socket. Then connect one socket terminal to one side of the 110-volt lighting circuit. Connect the other terminal of the socket to the armature shaft. Then connect the other side of the lighting circuit to a commutator segment. If the bulb lights, the armature is grounded.

b. Countershaft and Bearings. (1) Examine the bearing surfaces of the countershaft. If they are scored, replace the entire shaft.

(2) If ball bearings are rough turning, noisy, or have excessive radial play, replace them.

c. Sheaves and Fan. The sheaves and fan require replacement if they are broken, or have sharp edges which are cutting the V-belts.

d. Mounting Parts. Replace the generator mounting base if the bearings do not fit snugly in each end or if they are broken.

23. ASSEMBLY OF MOTOR GENERATOR.

CAUTION: Internal-external-tooth lockwashers must be reinstalled on all screws exactly as removed

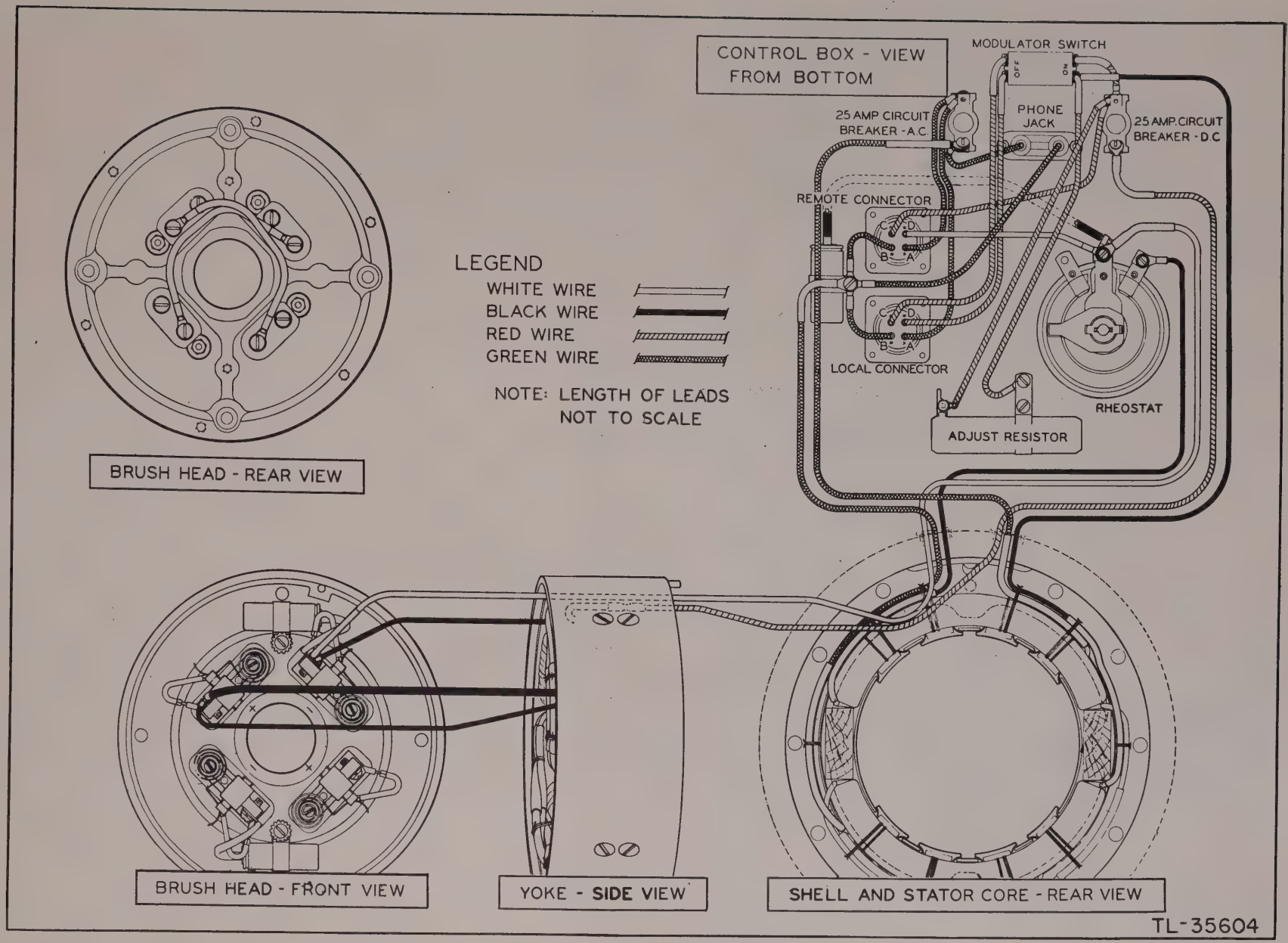

Figure 15. Practical wiring diagram.

to prevent radio interference. See paragraph 20*e* for location of these lockwashers.

a. Countershaft Assembly. (1) Press the rear bearing (fig. 11 (127)) on the countershaft (fig. 12 (122)).

(2) Insert key in countershaft keyway. Insert countershaft through generator end of generator mounting base and slide the fan and then the sheave (fig. 12 (121)) on the shaft. Align the keyway in the sheave and the fan with the key in the countershaft.

(3) Insert the countershaft into the front bearing (fig. 12 (123)), and tap on the end of the shaft with a soft mallet until it is tightly fitted.

(4) Tighten the socket setscrews in the sheaves and the fan. Install the retaining ring (fig. 11 (124)), behind the rear bearing (fig. 11 (127)) and the bearing cap (fig. 12 (129)) over the front bearing (fig. 12 (123)), fastening with four No. 10-32 screws and lockwashers.

(5) Replace the generator mounting base (fig. 12 (119)) on the generator mounting bracket (fig. 12 (118)), fastening with four 3/8-inch hexagonal screws and lockwashers. If the mounting bracket was removed from the base (fig. 11 (131)), replace it.

b. V-belts and Guard Assembly. Replace the two belts on the sheaves and slide the motor on the base to obtain proper tension. Tighten the four bolts holding the motor after tension adjustment is made (par. 14).

(2) Replace the belt guard. Slide the guard over the belts and sheaves, and fasten it on the generator end with three No. 10-32 screws and lockwashers.

(3) Bolt the belt guard bracket to the base with the 3/8-inch hexagonal screws and lockwashers.

c. Generator Assembly. (1) Place the key in the countershaft, align the keyway in the armature shaft, and slide the armature over the countershaft until it is flush with the shoulder of the shaft.

(2) If the yoke and control box have been removed from the shell, reassemble them. Note that the brush head and yoke are fastened to the shell by four yoke bolts. *Refer to wiring diagrams (figs. 14 and 15) to make sure that all connections are correct.* Slide the complete yoke, shell, and brush head assembly over the armature. Fasten the shell to the generator mounting base with four shell bolts and lockwashers (fig. 9).

(3) Tighten the two locknuts on the armature shaft and slide the spark wheel assembly on the shaft. Place a lockwasher and collet washer (fig. 7) on the armature bolt. Then insert the bolt in the armature shaft and tighten. Fasten the ground plate to the spark wheel with three screws and lockwashers. Replace the brushes in their respective holders so that they seat properly on the commutator. Fasten the brush headband in place with the thumbscrew provided.

(4) Place the electrode grounding brush in its holder (fig. 4). Then assemble the spark wheel housing on the generator end, being careful not to drop out the brush. Fasten screws through the clamp ring into the brush head.

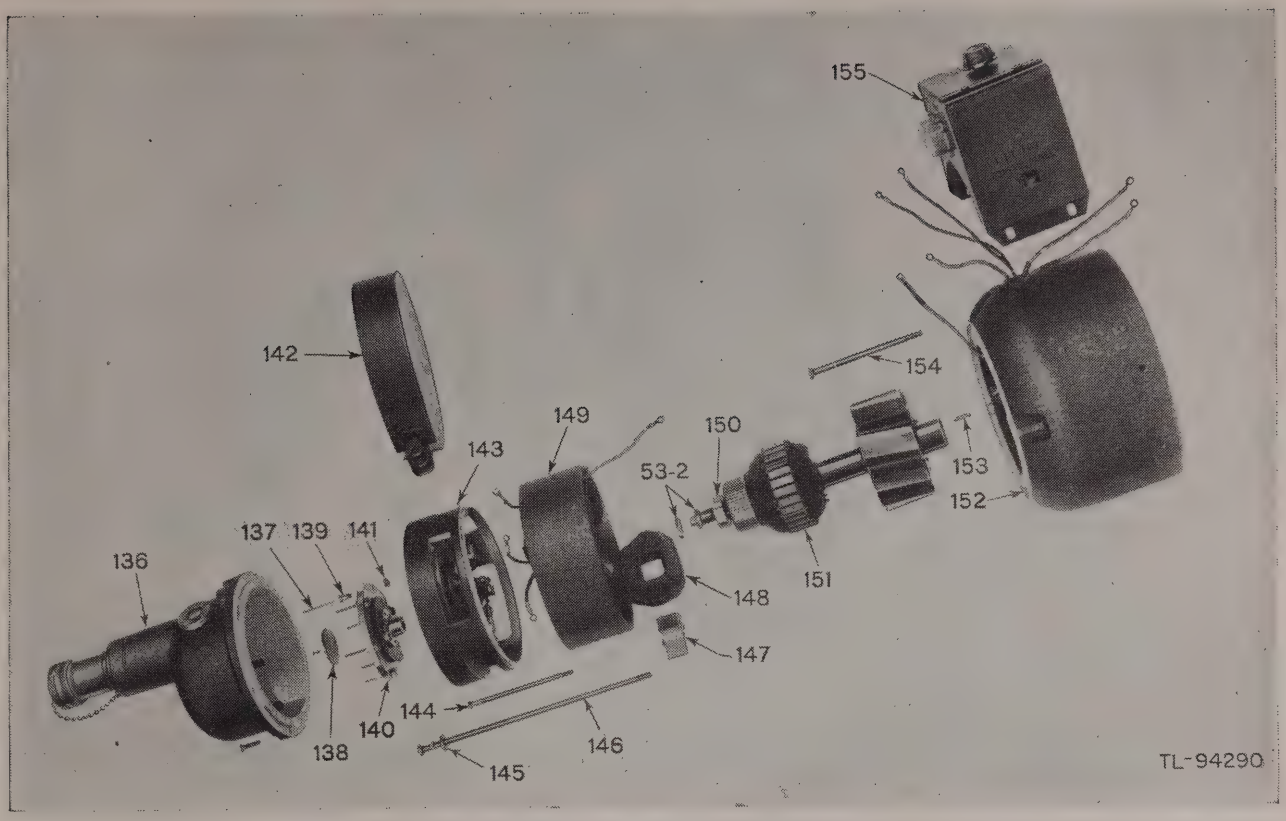

Figure 16. Generator parts.

Key to reference numbers in figure 16

53-2	Locknut
136	Spark-gap housing assembly
137	Electrode
138	Brush plate
139	Collet screw
140	Spark wheel assembly
141	Collet nut
142	Brush headband
143	Brush head assembly
144	Brush head bolt
145	Collet washer
146	Armature bolt
147	Pole piece
148	Field coil
149	Yoke and coil assembly
150	Generator bearing
151	Armature and rotor assembly
152	Shell assembly
153	Armature key
154	Shell bolt
155	Control box assembly

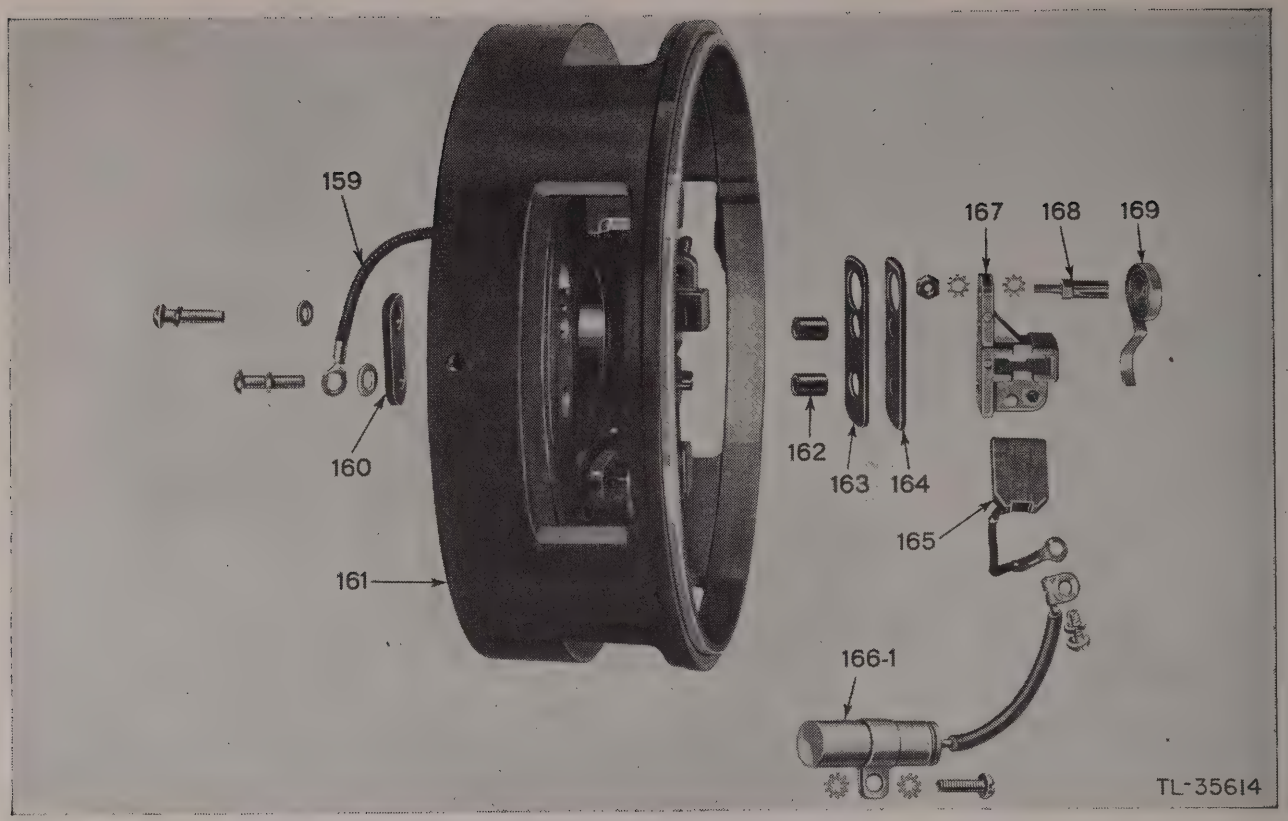

Figure 17. Brush head parts.

Key to reference numbers in figure 17

159	Brush jumper
160	Brush head insulation
161	Brush head
162	Brush head bushing
163	Brush-holder insulation
164	Brush-holder insulation
165	Brush
166-1	Capacitor
167	Brush holder
168	Brush spring post
169	Brush spring

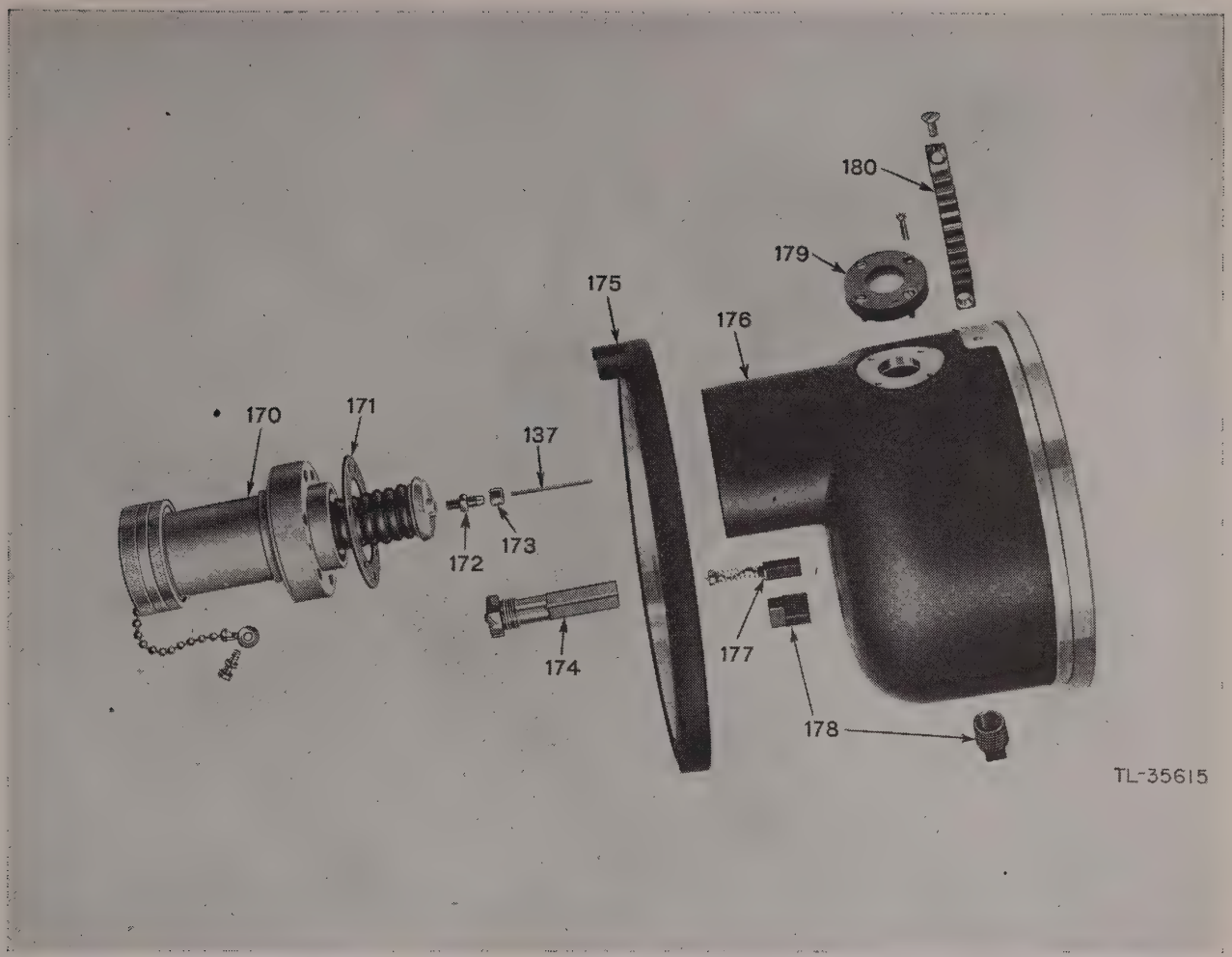

Figure 18. Spark wheel housing parts.

Key to reference numbers in figure 18

137	Electrode	175	Clamp ring
170	Pothead assembly	176	Spark-gap housing
171	Pothead gasket	177	Grounding brush assembly
172	Electrode chuck	178	Pipe plug
173	Chuck nut	179	Gits window
174	Brush holder	180	Phasing segment

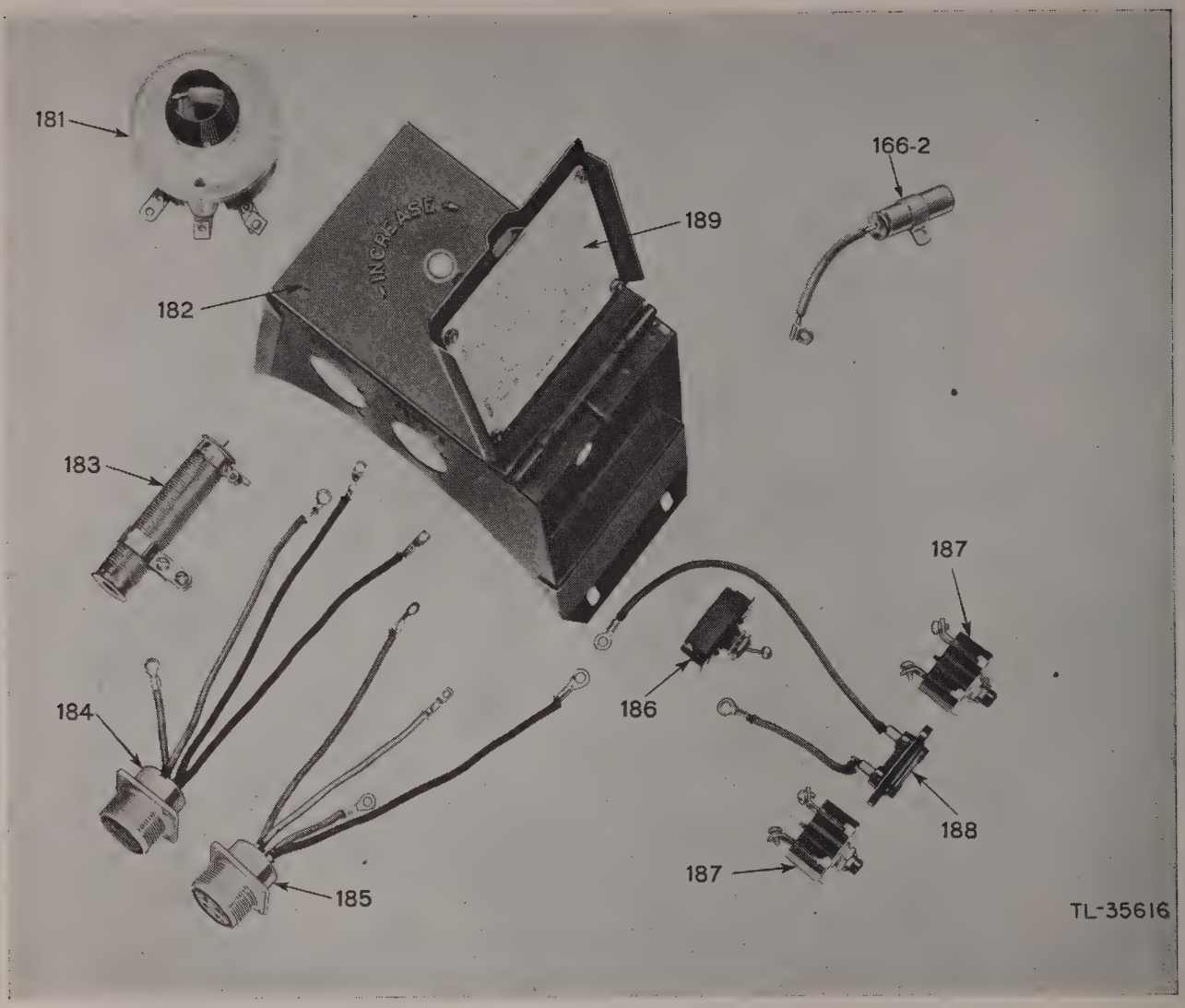

Figure 19. Control box parts.

Key to reference numbers in figure 19

166-2	Capacitor	185	Local connector assembly
181	Rheostat	186	Switch
182	Control box	187	Circuit breaker
183	Resistor assembly	188	Phone jack assembly
184	Remote connector assembly	189	Instruction plate

SECTION V
SUPPLEMENTARY DATA

24. MAINTENANCE PARTS LIST FOR MOTOR GENERATOR PU-20/C.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Running spares	Orgn stock	3d ech	4th ech	5th ech	Depot stock
		CONTROL GROUP							
Fig. 19 166-2	3DA100-205	**CAPACITOR, fixed:** paper; 100,000 mmf ± 10%; 40 vdcw; Tobe ※2354.	4	2		*	*	*	
183	3Z4805-9	**RESISTOR, adjustable:** wire wound; 5 ohms ± 10%; 40 w; WL type B; HL part AA815.	1	0		*	*	*	
181	3Z7010-10	**RESISTOR, variable:** 10 ohms; 100 w; Ohmite model K, ※0446.	1	0		*	*	*	
		GENERATOR GROUP							
Fig. 16 150	3H2342B/B2	**BEARING, ball:** Ahlberg ※6203GG; Fafnir ※203KDD; Federal ※1203FF; Hoover ※77203; M-R-C ※203SFF; McGill ※203FF; ND ※77503; Norma-Hoff ※203PP; SKF ※6203ZZ; Torrington ※T77203; Willys ※A-6299; (for outboard end of generator armature).	1	0			*	*	
123	3H320-13	**BEARING, ball:** Ahlberg ※6206GG; Fafnir ※206WDD and 206KDD; Federal ※1206MFF and 1206FF; Hoover ※772206; M-R-C ※206MFF; McGill ※206FF; ND ※77206 and 77506; Norma-Hoff ※206PP; SKF ※6206ZZ; Torrington ※T77206; Rel ※10797; (for countershaft support).	1	0			*	*	
Fig. 11 127	3H305-84	**BEARING, ball:** single row radial; double shield; steel; 0.7874″ bore, 2.0472″ OD, 0.5906″ wd; 7 balls, 13/32″ diam; ND 77604; (for countershaft support).	1	0			*	*	
Fig. 10 133	3H2405-1/B7	**BELT, "V" type:** Allis-Chal Tex rope, Super 7; AC-A-46.	2	4		*	*	*	
Fig. 18 177	3H2422/B31	**BRUSH ASSEMBLY:** grounding, w/pressure spring and shunt; Homelite ※AA-711.	1	0		*	*	*	
Fig. 17 165	3H2422/B30	**BRUSH:** Morganite grade CM-9; Homelite ※25198-1; (load current).	4	8		*	*	*	

* Indicates stock available.

24. MAINTENANCE PARTS LIST FOR MOTOR GENERATOR PU-20/C (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Running spares	Orgn stock	3d ech	4th ech	5th ech	Depot stock
Fig. 18 172	3H2422/C20	**CHUCK:** electrode; brass clamp; Homelite ※25554.	1	0				*	
137	3H1916/E25	**ELECTRODE:** tunsten rod; Homelite ※25495.	7	0		*	*	*	
173	3H2422/N10	**NUT, chuck:** brass; Homelite ※25553.	1	0				*	
Fig. 16 141	3H1916/N20	**NUT, collet:** brass; nickel-plated; Homelite ※81052.	1	0				*	
138	3H1916/P16	**PLATE, brush:** copper disk; Homelite ※25491.	1	0				*	
139	3H1916/S12	**SCREW, collet:** brass; nickel-plated; Homelite ※25492.	6	0				*	
		MOTOR GROUP							
	3H3003-3	**MOTOR, AC:** 3 hp; 115/230 v. AC, 60 cyc, single phase; 1,800 rpm; GE model 5KC225H2; WC-225 frame; (open ball bearings; windings specially treated to meet Signal Corps Spec 71-2202-A, dated April 1944; HL ※25736).	1	0				*	
	3H2422	**GENERATOR:** dual voltage, 120 v AC, 1,400 w. 400 cyc; 26 v DC, 14.3 amp; HL ※25564.	1	0				*	

* Indicates stock available.

Order No. 2914-MPD-44; 2252 Copies, Nov. 44.

THIS SUPPLEMENT WILL REMAIN IN EFFECT ONLY UNTIL THE INFORMATION IS PUBLISHED IN AN OFFICIAL DEPARTMENT OF THE ARMY PUBLICATION.

SUPPLEMENT

30 AUGUST 1951

SUPPLEMENT TO

TM 11-978

MOTOR GENERATORS PU-20/C AND PU-20A/C

The following information, published on Order No. 19703-Phila-51-11, supplements TM 11-978, 21 November 1944, as changed by Changes No. 1, 6 May 1949. The serial numbers of the equipment covered in this supplement are:

NAME	SERIAL NUMBERS
Motor Generator PU-20B/C	1 to 602 incl

Personnel using this equipment and having custody of this technical manual will enter suitable notations beside each affected paragraph and figure in the technical manual to indicate the presence of this supplementary information.

Note. Motor Generator PU-20B/C, procured on Order No. 19703-Phila-51-11, is similar to Motor Generators PU-20/C and PU-20A/C covered in TM 11-978. The information contained in the technical manual pertaining to Motor Generators PU-20/C and PU-20A/C is equally applicable to PU-20B/C except as otherwise specified in this supplement.

Page VI. Fig. 1.1. Insert figure 1.2 after figure 1.1.

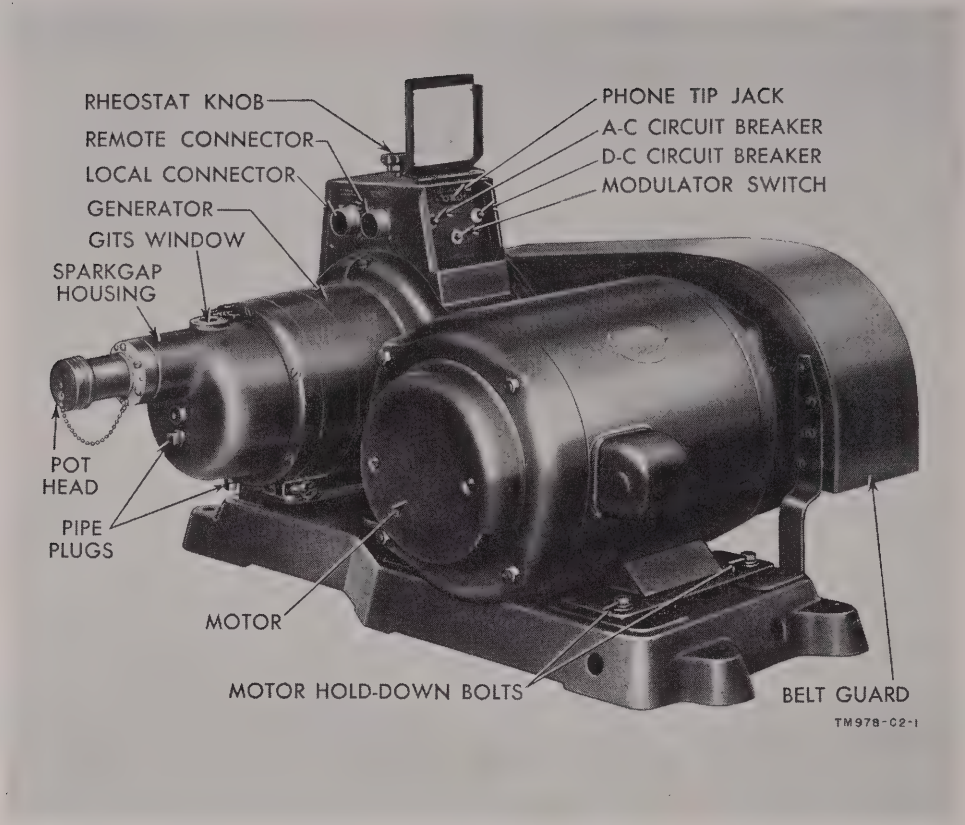

Figure 1.2 — Motor Generator PU-20B/C.

Page 1. Par. 1. Make the following changes in paragraph 1:

Delete subparagraph *a* and substitute the following:

a. MOTOR. The motive power for these units is a 3-horsepower, 1,750-rpm (revolution-per-minute), 115/230-volt, single-phase, 60-cycle electric motor. (For the PU-20/C motor, the rpm are 1,800.)

Add the following after subparagraph *d*:

d.1. TOOLS AND SPARE PARTS, PU-20B/C. The following tools and spare parts are supplied with Motor Generator PU-20B/C:

TOOLS

2 Sandpaper, #0000
1 Screwdriver TL-359/U, 8-inch
1 Wrench TL-111, adjustable 6-inch
1 Wrench, set-screw, 5/32-inch
1 Bag, cloth

SPARE PARTS

10 electrodes (137)

Page 4. Par. 11. In the table of paragraph 11, change the first lubricating material to read:

Approved symbol	*Standard nomenclature*	*Specification No.*
GL	Grease, instrument	U. S. Army 2-134

Page 4. Par. 12. Make the following changes in paragraph 12:

In the "Note" at the end of subparagraph *a*(7), change "PU-20A/C motor" to read: PU-20A/C and the PU-20B/C motors. Add the following after the last sentence of subparagraph *c*: Never wash sealed bearings. If dirty, wipe with a clean dry cloth. When replacing bearings, tap or press against the inner race only, because force used against any other part will result in damage to the bearing.

Page 7. Par.18. Delete the "Note" at the end of paragraph 18 and substitute the following:

Note. The motor bearings on PU-20A/C and PU-20B/C do not require preventive maintenance. The intervals given in the above table are maximum for normal operation. The intervals should be adjusted for abnormal operation.

Page 9. Par. 19. Change the first sentence of the "Note" following the heading of paragraph 19 to read: Motor Generators PU-20A/C and PU-20B/C are shipped moistureproofed and fungiproofed.

Page 11. Par. 20. Add the following at the end of subparagraph *e*(7): (PU-20A/C and PU-20B/C only).

Page 16. Fig. 14.1. In the caption, change "(PU-20A/C)" to read: *(PU-20A/C and PU-20B/C).*

Page 17. Fig. 15.1. In the caption, change "(PU-20A/C)" to read: *(PU-20A/C and PU-20B/C).*

Page 18. Par. 23. Add the following after paragraph 23:

23.1 Suppression Data

	Description of suppression application	*Suppression components*	*Size or value*	*Quantity*
EXCITER	Negative brushes bypassed to exciter housing.	Metal-clad capacitor. IET washer. Screw.	.1 uf No. 10 No. 10-32 x 3/8"	2 4 2
	Positive lead at field coils in yoke assembly bypassed to shell.	Metal-clad capacitor. IET washer. Split lockwasher. Flat washer. Screw.	.1 uf No. 10 No. 10 No. 10 No. 10-32 x 1/2"	1 1 1 1 1
CONTROL BOX	Center arm of rheostat bypassed to ground terminal in control box.	Metal-clad capacitor. ET washer.	.1 uf No. 8	1 1
	Terminal of d-c circuit breaker bypassed to control box.	Metal-clad capacitor. IET washer. Screw. Nut. Flat washer. Split washer.	.1 uf No. 10 No. 10-32 x 1/2" No. 10 No. 10 No. 10	1 2 1 1 1 1

Page 20. Fig. 17. In the legend for figure 17, add the following at the end of "166-1 Capacitor": (On the PU-20A/C and PU-20B/C this capacitor has a detachable lead.).

Page 22. Fig. 19. In the legend for figure 19, add the following at the end of "166-2 Capacitor": (On the PU-20A/C and PU-20B/C this capacitor has a detachable lead.).

Page 23. Sect. V. Add the following "Note" after the section heading:

Note. The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O&E, T/A, SIG 7 & 8, list of allowances of expendable material, or another authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is SIG 7 & 8-PU-20/C. For an index of available supply catalogs in the Signal portion of the Department of the Army Catalog, see the latest issue of SIG 1, Introduction and Index.

Page 24. Par. 24. Add the following after paragraph 24:

24.1 Identification Table of Parts for Motor Generator PU-20B/C (Sig C stock No. 3H3370-20B)

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
	Motor, a-c (see par. 24.2 for motor parts).	Provides driving power for generator.	3H3000A300-5
	Generator, a-c and d-c (see par. 24.3 for generator parts).	Generates a-c and d-c electricity.	3H2440-50
	Generator control group (see par. 24.4).		
	Tools and accessory group (see par. 24.5).		
	Common hardware group (see par. 24.6).		

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
O-11	BEARING, ball: single row, radial; double metal seal; light-duty, cartridge type; 1/1811″ bore, 2/4409″ OD, .9375″ wd; nine balls; packed w/low temp grease; Norma Hoffmann Bearings Corporation bearing #3506.	Supports armature E2.	3H320-155
1	BRUSH ASSEMBLY: brush ring assembly w/short circuiter; 5-15/16″ lg x 5-15/16″ wd x 3⅜″ d o/a; 1¼″ dia center hole mounts on shaft; Brown-Brock part/dwg #B3506.	Used in starting the motor.	3H550-61
E8	BRUSH, electrical contact: wedge-shaped; 1⅜″ lg, 1⅛″ wd, .340″ thk; carbon; consists of two brushes joined by a 4½″ lg #16 wire pigtail; Brown-Brock part/dwg #A2956.	Used during starting period.	3H525-268
A5	BUMPER: neoprene; cylindrical; 31/64″ lg x 4¼″ dia o/a; Brown-Brock part/dwg #A-2959.	Absorbs shock of flyweights.	6Z1650-13
E7	INSULATOR, ring: phenolic; round, flat, washer-shaped; D—6¼″, H—5¾″, T—15/64″; Brown-Brock part/dwg #B3434.	Insulates fan from armature.	3G330-9
O-14	RING, retainer: steel; ring-shaped w/projected ears; ID 1.156″, OD 1.73″, thk .050″; Waldes catalog #NAS-51-125.	Holds spring retaining cup.	2Z7858-245
O-17	RING, retainer: spring steel; split-ring shaped; 2⅜″ OD, 2⅛″ ID, .125″ thk; Brown-Brock part/dwg #A-1886-10.	Holds retaining washer on short circuiter hub.	2Z7858-246
E6	ROTOR, motor: 110/220 v, 60 cyc, single-phase, 17″ lg, 5.963″ dia; Brown-Brock part/dwg #B-3437-G11.	Consists of motor armature and shaft.	3H5199-11
O-18	SLEEVE, insulating: bumper-sleeved; neoprene; cylindrical; 2⅜″ OD, 2¼″ ID, 13/16″ wd; Brown-Brock part/dwg #A2951.	Insulates flyweights from short circuiter hub.	3G2263-10
O-13	SPRING: helical compression type; .120″ dia spring steel wire; free lgth 6″ x 1-13/16″ dia; 8 turns; Brown-Brock part/dwg #A3271-4.	Holds brush ring assembly in place.	3H5255-48

24.2 Motor Parts (contd)

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
O-20	SPRING: 2⅛″ lg x 1⅛″ h x ¼″ wd o/a; approx 4½ turns; Brown-Brock part /dwg #B3310.	Brush spring.	3H5255-47
O-24	SPRING: flat type; 1½″ lg x ⅝″ wd x 21/32″ thk o/a; Brown-Brock part/dwg #A2960.	Used for centering brush ring.	3H5255-46
E5	STATOR, motor: 110/220 v, 60 cyc, single-phase, four windings; cylindrically-shaped, 7¾″ lg, 10¼″ dia; Brown-Brock part #E.S. 7005, no dwg.	Stator portion of motor.	3H5340A-20
H42	WASHER, thrust: phenolic; round; 2-11/32″ OD, 1-19/64″ ID, 1/16″ thk; Brown-Brock part/dwg #A2515-22.	Insulates flyweights from short circuiter hub.	6L75050-16
H51	WASHER, thrust: phenolic; round; 2⅞″ OD 1/32″ thk 2-17/32″ ID; Brown-Brock part/dwg #A-2955.	Transmits thrust from short circuiter hub to brush ring.	6L75050-17

24.3 Generator Parts

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
O-105	BEARING, ball: single row, radial; double-shielded; light duty; .669″ bore, 1.574″ OD, .472″ wd; eight balls; packed with low temp grease; ND part #77503, spec X1H.	Supports d-c end of generator armature.	3H2342B/B2
O-133	BEARING, ball: single row, radial; double-shielded; light duty; 1.181″ bore, 2.4409″ OD, .6299″ wd; nine balls; lubricated w/U.S. Army Spec 2-134 low temp grease; ND part #77506, spec X1H.	Supports generator end of countershaft.	3H320-13
O-104	BEARING, ball: single row, radial; double-shielded; medium duty; .787″ bore, 2.047″ OD, .591″ wd; seven balls; lubricated w/U.S. Army Spec 2-134 low temp grease; ND part #77604, spec X1H.	Supports one end of countershaft.	3H305-84
H142	BOLT, machine: steel; cadmium or zinc-plated w/iridite; hex. headed; 5/16″-24, NCT, 1″ min lgth; 11-13/16″ nominal lgth; HL part #80092-1.	Holds armature to countershaft.	6L605-11.7
H121	BOLT, machine: steel; zinc-plated w/iridite; hex. headed; 5/16″-18, NCT, 5½″ nominal lgth; HL part #80190-1.	Holds brush head assembly.	3H4531-4/S4
H105	BOLT, machine: steel; zinc-plated w/iridite; hex. headed; ¼″-20, NCT, 1″ min lgth; 5⅛″ nominal lgth; HL part #80191-1.	Holds brush head assembly to generator housing.	3H4531-4/S2
E104	BRUSH, electrical contact: rectangular; 2⅛″ lg, 5/16″ wd, 5/16″ thk; pressure spring w/shunt 1¼″ lg; carbon; HL part #AA-711.	Used for grounding spark wheel assembly.	3H2422/B31
E155	BRUSH, electrical contact: rectangularly shaped; 1″ lg, ¾″ wd, ¼″ thk; carbon; has 2¼″ lg pigtail w/terminal for #8 screw; HL part #25198-1.	Picks up d-c from commutator.	3H2422/B30
C101	CAPACITOR, fixed: paper dielectric; one section; 100,000 uuf, 100 v d-c; hermetically sealed metal can; 1-7/16″ lg, ⅝″ dia; h ⅝″; Tobe Deutschmann part #S1L7.	Reduces ripple.	3D444

24.3 Generator Parts (contd)

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
O-121	COLLET: screw collet; brass, nickel-plated; HL part/dwg #25492.	Holds electrode.	3H1916/S12
E131	ELECTRODE: tungsten; 1⅝″ lg, .080″ dia; must be straight; HL part #25495.	Permits the flow of sparks.	3H1916/E25
H160	FITTING, pipe: pipe plug; plastic; ⅜″ male; 7/16″ sq head; HL part/dwg #25509.	To close holes in spark gap housing subassembly.	3H2422/P10
108	GASKET: vellumoid; seven holes; round; 2-9/16″ dia x 1/16″ thk; HL part/dwg #25555.	Seals between pothead subassembly 107 and housing A-104.	2Z4868.1119
109	GASKET: neoprene; center hole only; round; 1¾″ dia x 3/32″ thk; HL part/dwg #25772.	Seals cap assembly.	2Z4868.1120
H182	HOLDER, electrode: brass; has hole in center for electrode, clamps tight when tapered nut is tightened; screws into 10-32 tapped hole; HL part/dwg #25554.	Holds electrode.	3H2422/C20
E134	INSULATOR, disk: plastic; brown, round, flat, disk shaped; D—3″, T—5/16″; HL part #25497.	Insulates spark rotor from the rotor collet.	3G280-43
H183	NUT, collet: brass, nickel-plated; ¼″-20; HL part/dwg #25553.	Used with electrode holder.	3H2422/N10
H262	NUT, plain, hexagon: brass; nickel-plated; ¼″-28 NFT; 7/16″ wd; o/a h 13/64″; HL part #81052.	Used with collet.	3H1916/N20
E101	ROTOR, generator: 110 v a-c; 28 v; 12-3/16″ lg, 4.964″ dia; moisture and fungi-resistant; HL part #AA-60213-1.	Serves as rotating portion of generator.	3H137H-3
E130	STATOR, generator: 110 v, 400 cyc, single-phase; two windings; cylindrically-shaped; 5″ lg, 8½″ dia; moistureproofed and fungiproofed; HL part/dwg #AA-31380.	Comprises field for a-c portion of generator.	3H5259-11
E122	WINDING, generator field: two windings, 28 v d-c; 1-7/32″ thk, 1⅛″ x 1⅛″ ID, 2⅞″ x 2⅞″ OD; HL part #AA-31386.	D-c winding.	3H8400.1-12

24.4 Generator Control Parts

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
K101	CIRCUIT BREAKER: SPST; a-c, 110 or 220 v, 25 amp; d-c, 30 v 25 amp; thermal trip release; manual reset; bakelite case; 1⅜″ lg, 1⅛″ wd, ¾″ d; mtg by one hex. nut; two terminals; Spencer Thermostat Co. model #PSM-25.	Protects a-c and d-c portion of generator.	3H900-25-13
R101	RESISTOR, adjustable: 5 ohms, tolerance ±10%; 40 w power dissipation; adjustable type, one slide; 3½″ lg, ¾″ spool dia; vitreous enamel coating; HL part #25476.	Limits generator voltage.	3Z4805-9
R102	RESISTOR, variable: wire-wound element; rotating brush type; one section, 10 ohms, tolerance ±10%; 100 w nominal power rating; three terminals; ceramic body; 3⅛″ dia, 1¾″ d; shaft, round w/flat portion, ¼″ dia, ⅞″ lg from mtg surface; Ohmite Mfg. Co. model K-17662, dwg #A-18213F.	Controls generator voltage.	3RP3301
S101	SWITCH, toggle: DPST; 12 amp, 125 v; phenolic case; 1¾″ lg, ¾″ wd, ¾″ d; four terminals, screw type, two located at each end; single hole mtg type; AH&H part #82143.	Used for changing from local to remote control.	3Z9508

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
	ABRASIVE, sheet: sandpaper; grit size #0000; 11″ lg x 9″ wd; Federal specification P-P-111.	To clean commutator.	6Z7500-0000
	BAG: tool; canvas, olive drab; 13″ x 11″ wd x 6½″ d; zipper fastening on two sides; webbing hand grip; two compartments; weatherproof; HL part/dwg #32316.	To carry accessory parts.	6Q2152
O-401	BELT, "V": rubber composition; 9/32″ wd inside, ½″ wd outside, 11/32″ thk, outside circumference 43″; oil resisting, static dissipating; Allis-Chalmers Mfg. Co.; HL part #25920; matched pair.	Transmits power from motor to generator.	3H2405-1/B7
	COVER: canvas, olive drab; rectangular shape w/cylindrical projection on one side; 30″ lg x 29½″ wd x 16″ d; fastened to motor generator by tightening drawstring; HL part/dwg #32317.	To protect generator.	3H1380.8-5
	SCREWDRIVER: for slot drive; 11¾″ o/a lgth; Stanley Tools #25.		6R-16013
	WRENCH: adjustable; 0″ to 13/16″ range; 6″ lg x 1¾″ wd x 7/16″ thk; 220° offset from handle; Crescent Tool Co. part #A16.		6R55006
	WRENCH: Allen socket screw type, lg arm; 90° bend; for 5/16″ Allen setscrew; The Allen Mfg. Co. code #532L.		6R57400-10.2

24.6 Common Hardware

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
O-5	KEY, machine: sq; steel w/cronak finish; ¼″ x ¼″ x 2″; Brown-Brock part #A-2169.	Keeps pulley from turning on shaft.	3H2676-5
O-108	KEY, machine: sq; CRS; 3/16″ sq x 13/16″ lg; HL part/dwg #15008.	Used at connection between countershaft and armature shaft.	3H4523-1/K1
H260	NUT, lock: J-type; steel; .021″ thk; 5/16″ wd; ⅜″ lg; for 6-32 screw; Tinnerman Prod part #6100M, type J.	Used with bolt H254.	6L3656-32
H5	NUT, plain, hexagon: steel; 5/16″-18 NCT; Brown-Brock part #1778.	Used with through-bolt H13.	6L3505-18-951
H50	NUT, plain, hexagon: steel; ¼″-20 NCT; Brown-Brock part #1620.	Used with screw H48.	6L3504-20-7C
H209	NUT, plain, hexagon: steel; 8-32 NCT; HL part #81009-1.	Used with bolt H207.	6L3608-32.3
H219	NUT, plain, hexagon: steel; 10-32 NCT; HL part #81010-1.	Used with bolt H217.	6L3610-32.6
H244	NUT, plain, hexagon: steel; 4-36 NCT; HL part #81001-1.	Used with bolt H220.	6L3604-36-4
H250	NUT, plain, hexagon: steel; 6-32 NCT; HL part #81002-1.	Used with bolt H248.	6L3606-32.3
H330	NUT, plain, hexagon: steel; 6-32 NCT; HL part #81002.	Holds brush spring post to brush holder.	6L3606-32-5
H450	NUT, plain, hexagon: steel; ¼″-20 NCT; HL part #81013-1.	Used with bolt H442.	6L3504-20.3S
H438	NUT, plain, square: steel; ⅜″-16 NCT; HL part #81024-1.	Used with bolt H426.	6L3806-16-10
H48	SCREW, cap: steel; Fil H; ¼″-20 NCT; 2½″ nominal lgth; Brown-Brock part #1154.	Clamps fan to insulating ring.	6L4904-40.12S
H152	SCREW, cap: steel; hex. head ⅜″-16 NCT; 1″ lg; HL part #80095-1.	Holds mounting bracket to shell.	6L4906-16.81C

24.6 Common Hardware (contd)

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
H197	SCREW, cap: steel; Allen type; 5/16″-24 NFT; nominal lgth ½″; HL part #80176-1.	Holds stator core assembly in position.	6L4905-8.81C
H418	SCREW, cap: steel; ⅜″-16 NCT; 1¼″ nominal lgth; HL part #80096-1.	Holds generator to the mounting base.	6L4906-20.81C
H426	SCREW, cap: steel; ⅜″-16 NCT; 1½″ nominal lgth; HL part #80097-2.	Holds motor to base.	6L4906-24.81C
H442	SCREW, cap: steel; SAE; #1035; ¼″-20 NCT; ⅝″ nominal lgth; HL part #80048-1.	Holds belt guard to bracket.	6L20924-10.81C
H454	SCREW, cap: steel; ⅜″-16 NCT; ¾″ nominal lgth; HL part #80171-1.	Holds belt guard bracket to mounting base.	6L4906-12.16C
H401	SCREW, drive: hammer drive; steel; cadmium or zinc plate with iridite; #4; 5/16″; Parker-Kalon type U, #4 drive screw.	Holds nameplate N401.	6L5024-4C
H405	SCREW, drive: hammer drive; steel; cadmium or zinc plate with iridite special hardness; #2; 3/16″ lg; Parker-Kalon type U, #2 drive screw.	Holds nameplate N402	6L5022-3C
H1	SCREW, machine: steel; flathead; 10-24 NCT; ⅜″ nominal lgth; Brown-Brock part #A-2555.	Holds index arm retainer O-14 to commutator cover A1.	6L20910-12.51S
H3	SCREW, machine: steel; oval head; ¼″-20 NCT; 1″ nominal lgth; Brown-Brock part/dwg #A-2400-4.	Holds end cap to commutator cover.	6L20924-16.51S
H55	SCREW, machine: steel; Fil H; 5/16″-18 NCT; ⅝″ nominal lgth; Brown-Brock part #2176.	Fastens conduit box bracket to stator.	6L20925-10.12S
H59	SCREW, machine: steel; roundhead; 10-24 NCT; ⅜″ nominal lgth; Brown-Brock part #A-1757.	Holds conduit box cover to bracket.	6L7024-6.49S

24.6 Common Hardware (contd)

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
H195	SCREW, machine: steel; roundhead; 8-32 NCT; nominal lgth 5/8″; HL part #80024-1.	Holds capacitor to shell assembly.	6L6832-10.49S
H203	SCREW, machine: steel; Fil H; 8-32 NCT; 1/2″ nominal lgth; HL part #80022-1.	Holds lead to capacitor.	6L6832-8.12S
H220	SCREW, machine: steel; roundhead; 4-36 NCT; 1/4″ nominal lgth; HL part #80006-1.	Fastens instruction plate to control box.	6L6436-4.49S
H224	SCREW, machine: steel; Fil H; 8-32 NCT; 1/4″ nominal lgth; HL part #80018-1.	Holds connector assembly to control box.	6L6832-4.12S
H254	SCREW, machine: steel; Fil H; 6-32 NCT; 7/16″ nominal lgth; HL part #80015-1.	Holds lead to variable resistor.	6L6632-7.12S
H296	SCREW, machine: steel; roundhead; 8-32 NCT; 7/16″ nominal lgth; HL part #80021-1.	Holds terminal of brush to brush holder assembly.	6L6832-7.49S
H312	SCREW, machine: steel; roundhead; 10-32 NCT; 3/8″ nominal lgth; HL part #80029-1.	Holds capacitor to brush head.	6L7032-6.49S
H131	SCREW, machine: steel; Fil H; 10-32 NCT; 1/2″ nominal lgth; HL part #80033-1.	Holds bearing cap.	6L7032-8.12S1
H280	SCREW, machine: steel; roundhead; 10-32 NCT; 7/8″ nominal lgth; HL part #80040-1.	Holds brush holder and post assembly to brush head.	6L7032-14.49S
H164	SCREW, machine: steel; Fil H; 10-32 NCT; HL part #80041-1.	Holds pothead assembly to spark gap housing.	6L7032-16.12S
H187	SCREW, machine: steel; flathead; 1/4″-20 NCT; 3/4″ nominal lgth; HL part #80053-1.	Holds pole piece to yoke.	6L20924-12.47S
H146	SCREW, machine: steel; flathead; 1/4″-20 NCT; 1″ nominal lgth; HL part #80058-1.	Holds spark gap housing assembly to brush head assembly.	6L4904-16.20G

24.6 Common Hardware (contd)

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
H117	SCREW, machine: steel; Fil H; ¼″-20 NCT; ⅜″ nominal lgth; HL part #80136-1.	Holds control unit to generator housing.	6L20924-12.12S
H207	SCREW, machine: steel; roundhead; 8-32 NCT; 3¾″ nominal lgth; HL part #80139-1.	Holds adjustable resistor to control box.	6L20908-60.49S
H217	SCREW, machine: steel; roundhead; 10-32 NCT; ½″ nominal lgth; HL part #80157-1.	Used to hold bracket.	6L7032-8.49S
H274	SCREW, machine: brass; flathead; 6-32 NCT; 5/16″ nominal lgth; HL part #80192.	Fastens rotor insulator to collet.	6L6632-5.7
H268	SCREW, machine: brass; flathead; 6-32 NCT; ½″ nominal lgth; HL part #80193.	Holds spark rotor to insulator.	6L6632-8.7
H176	SCREW, machine: steel; flathead; 8-32 NCT; ⅜″ nominal lgth; HL part #80223-1.	Holds phasing segment to housing.	6L6832-12.47S
H178	SCREW, machine: steel; Fil H; 6-32 NCT; 5/16″ nominal lgth; HL part #80230-1.	Holds gits window to housing.	6L6632-5.12S
H135	SCREW, machine: steel; roundhead; 6-32 NCT; 5/16″ nominal lgth; HL part #80247-1.	Holds brush plate to spark wheel assembly.	6L6632-5.49S
H415	SCREW, machine: steel; 10-32 NCT; ½″ nominal lgth; HL part #80033-1.	Holds belt guard to generator base.	6L7032-8.12S
H125	SCREW, set: steel; Allen type; 5/16″-18 NCT; ⅜″ nominal lgth; HL part # 80413-1.	Locks fan to shaft.	6L18605-6.39
O-112	SPLICE, conductor: compression type; accom 2 continuous conductors of #16 #14 AWG wire; bronze; ⅞″ lg; 5/32″ dia; Thomas & Betts; catalog #BB.	Connects shunt windings of field coils.	6J829-1

24.6 Common Hardware (contd)

Ref symbol	*Name of part and description*	*Function of Part*	*Signal Corps stock No.*
O-115	SPLICE, conductor: compression; accom 2 continuous conductors of #12 to #10 AWG wire; bronze; 13/16″ lg; 15/64″ dia; Thomas & Betts; catalog #CC-2.	Connects series windings of field coils.	6N5610-1
E115	TERMINAL, lug: rd tongue end type; bronze; accom #12 and #10 AWG wire; 27/32″ lg; 3/8″ wd; 7/32″ thk; one hole for #10 screw; Thomas & Betts; catalog #C-26.	Used on field coil E125.	3Z12060-20.5
E116	TERMINAL, lug: rd tongue end type; bronze; #16-14 AWG wire; 13/16″ lg; 5/16″ wd; 3/16″ thk; one hole for #10 screw; Thomas & Betts; catalog #B-87.	Used on field coil E122.	3Z12041-6.8
H210	WASHER, extruded: steel, cadmium plate with iridite; rd, 5/32″ ID, 7/8″ OD, 3/16″ thk; HL part/dwg #25477-1.	Used for mounting adjustable resistor.	6L58422C-1
H141	WASHER, flat: rd; CRS; 5/16″ nominal bolt size; HL part/dwg #25496.	Used under head of armature bolt H142.	3H1916/W2
H258	WASHER, flat: rd; steel; #6 nominal screw size; HL part #84018-1.	Used with screw H254.	6L58006C-4
H288	WASHER, flat: rd; steel; #10 nominal screw size; HL part #84003-1.	Used with bolt H280.	6L58010C
H412	WASHER, flat: rd; steel; #10 nominal screw size; HL part #84003-1.	Used with bolt H415.	6L58010C
H430	WASHER, flat: rd; steel; center hole 7/16″ dia; 1″ OD; HL part #84030-1.	Used with bolt H426.	6L58027C
H17	WASHER, lock: slit helical ring; steel; 5/16″ nominal bolt size; Brown-Brock part #1864.	Used with through-bolt H13.	6L71005-25

24.6 Common Hardware (contd)

Ref symbol	*Name of part and description*	*Function of part*	*Signal Corps stock No.*
H49	WASHER, lock: slit helical ring; steel; ¼″ nominal bolt size; Brown-Brock part #1261.	Used with bolt H48.	6L71004-27
H101	WASHER, lock: slit helical ring; steel; ¼″ nominal screw size; HL part #83009-1.	Used with bolt H105.	6L71004-12C
H109	WASHER, lock: slit helical ring; steel; 5/16″ nominal screw size; HL part #83002-1.	Used with bolt H121.	6L71005-15
H113	WASHER, lock: rd; internal-external teeth; steel; ¼″ nominal screw size; Shakeproof part #4014-22.	Used with bolt H117.	6L72214-22
H127	WASHER, lock: slit helical ring; steel; #10 nominal screw size; HL part #83006-1.	Used with fillister-head bolt H131.	6L70010-15C
H138	WASHER, lock: slit helical ring; #6 nominal screw size; HL part #83004-1.	Used with bolt H135.	6L70006
H156	WASHER, lock: slit helical ring; steel; ⅜″ nominal screw size; HL part #83018-1.	Used with bolt H152.	6L71006-5C
H202	WASHER, lock: rd; steel; #8 nominal screw size; HL part #83000-1.	Used with bolt H203.	6L70008C-7
H206	WASHER, lock: rd; steel; #8 nominal screw size; HL part #83022-1.	Used with bolt H203.	6L72208C
H208	WASHER, lock: rd; external teeth; steel; #8 nominal screw size; HL part #83029-1.	Used with nut H209.	6L72108C
H216	WASHER, lock: rd; internal-external teeth; steel; #10 nominal screw size; HL part #83044-1.	Used with bolt H217.	6L72210-14C

24.6 Common Hardware (contd)

Ref symbol	*Name of part and description*	*Function of part*	*Signal Corps stock No.*
H212	WASHER, lock: rd; external teeth; steel; #4 nominal screw size; HL part #83036-1.	Locks leads to toggle switch.	6L72204C
H218	WASHER, lock: rd; slit helical ring; steel; #10 nominal screw size; HL part #83046-1.	Used with bolt H217.	6L70010-19
H240	WASHER, lock: slit helical ring; steel; #4 nominal screw size; HL part #83008-1.	Used with bolt H220.	6L70004-2C
H322	WASHER, lock: rd; external teeth; steel; #6 nominal screw size; Shakeproof part #1106.	Used with nut H330.	6L72106C
H409	WASHER, lock: slit helical ring; steel; #10 nominal screw size; HL part #83006-1.	Used with bolt H415.	6L70010-15C
H446	WASHER, lock: slit helical ring; steel; ¼″ nominal screw size; HL part #83009-1.	Used with bolt H442.	6L71004-12C
H456	WASHER, lock: slit helical ring; steel; center hole ⅜″ dia; ⅝″ dia OD; HL part #83018-1.	To maintain tightness of bolt H454.	6L71006C-2

TECHNICAL MANUAL

MOTOR GENERATOR PU-20/C AND PU-20A/C

CHANGES
No. 1

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *6 May 1949*

TM 11-978, 21 November 1944, is changed as follows:

The title of the manual is changed to read **MOTOR GENERATORS PU-20/C AND PU-20A/C.** The classification RESTRICTED is removed from the manual.

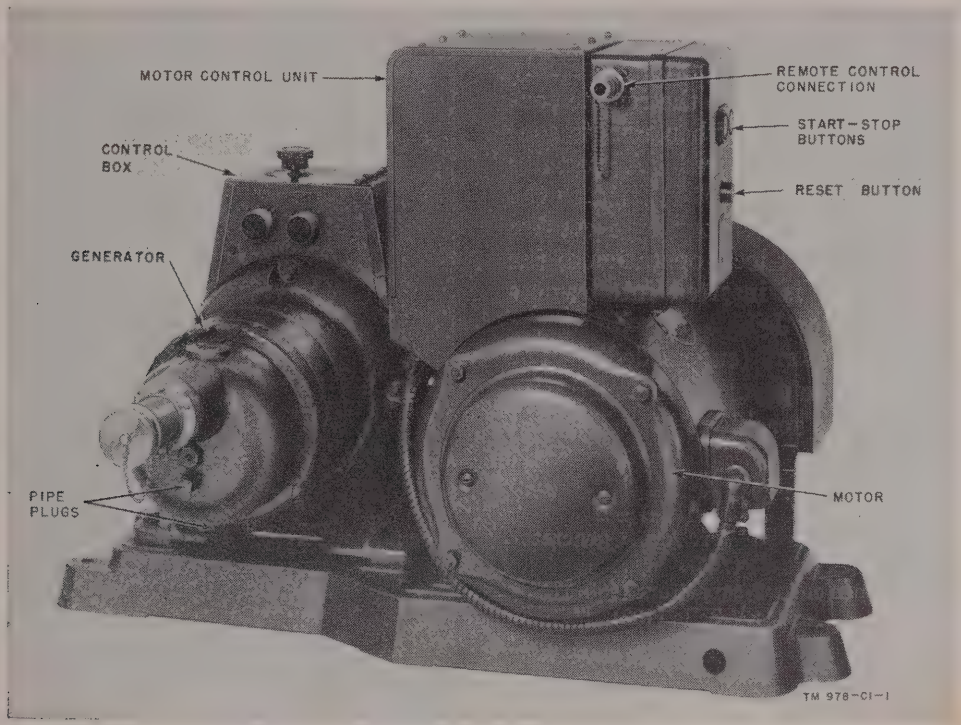

Figure 1.1. (Added.) *Motor Generator PU-20A/C.*

SECTION I
DESCRIPTION

Note. (Added.) Motor Generators PU-20/C and PU-20A/C are similar except that the latter includes a motor control unit which is mounted on a motor of different manufacture than the one used with the PU-20/C. Information which applies to the PU-20/C in this manual also applies to the PU-20A/C except where specified otherwise in these changes.

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1. Motor Generators PU-20/C and PU-20A/C (figs. 1 and 1.1)

a. MOTOR. The motive power for **each** unit is a 3-horsepower, 1,800-revolution-per-minute (rpm) **(1,750 rpm for the PU-20A/C motor),** 115/230-volt, single-phase, 60-cycle electric motor.

* * * * *

c. CONTROL SYSTEM.

(1) Control box. A weatherproof output * * * LOCAL connector (receptacle).

(2) (Added.) *Motor control unit (fig. 1.1).* The motor control unit (PU-20A/C only) consists of two pressed steel boxes con-

nected together and mounted on top of the motor. The larger box (terminal box) contains a terminal board and transformer (fig. 1.2). The smaller box (electromagnetic switch box) houses an electromagnetic switch and overload relay (fig. 1.3). A remote control connector receptacle (J–1) provides for local and remote control for starting and stopping the motor. START-STOP and RESET buttons protrude through the detachable cover of the electromagnetic switch box. The supplied remote control connector plug (P–2) and push-button assembly (fig. 1.4) is inserted into the remote control connection (J–1) when remote control of the motor is desired. A specially wired connector plug (P–1), tied to the electromagnetic switch box by a captive chain, provides for local operation of the motor when it is inserted into remote control connector J–1.

d. Tools and Spare Parts (superseded). The following tools and spare parts are included with each motor generator as specified:

PU–20/C

Tools	*Spare parts*
1 wrench, 7/16″-box and open end.	8 brushes, generator, (165).
1 wrench, 11/16″ x 9/16″-open end.	2 capacitors (166–1).
1 screw driver, 8″	4 V-belts (133).
1 wrench, setscrew, 5/16″.	
1 sheet crocus cloth.	

PU–20A/C

Tools	*Spare parts*
1 wrench, 7/16″-box and open end.	5 brush assemblies (177).
1 wrench, setscrew, 5/16″	8 brushes, generator (165).
1 screw driver, 8″	2 capacitors (166–1).
1 sheet crocus cloth	7 electrodes (137).
4 sandpaper, # 00	4 V-belts (133).

2. Dimensions

a. Motor Generator PU–20/C. Motor Generator PU–20/C * * * weighs 285 pounds.

b. (Added.) Motor Generator PU–20A/C. Motor Generator PU–20A/C is 28 inches wide, 35 inches long, 23½ inches high, and weighs 310 pounds.

3. Installation

a. Motor Generator PU–20/C * * * on the motor. **On the PU–20A/C, run the two line conductors through the hole in the bottom of the terminal box and connect them to the studs marked LINE (fig. 1.2). Position the links as necessary for the line voltage used. Refer to the wiring diagram located under terminal box cover.** Check the tension * * * approximately ½ inch (par. 14).

* * * * *

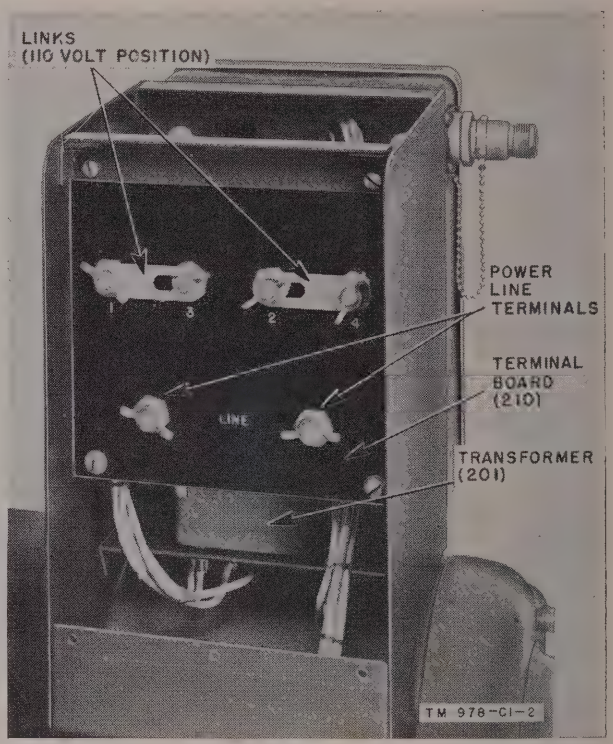


Figure 1.2. (Added.) *Terminal board (PU–20A/C).*

4. Operation

* * * * *

b. Connections for Operation (figs. 1 **and 1.1).**

(1) Plug the low-voltage * * * the REMOTE connector. **On the PU–20A/C, prepare the remote control push-button assembly by wiring it as shown on figure 1.4. For remote control of the motor, remove the captive male connector from remote control receptacle J–1 and insert the male connector of the remote control push-button assembly.**

(2) Make sure the * * * unit is started. **Start the PU–20/C unit by throwing the line switch to ON.** *Do not turn* **the modulator switch** *to ON* until the motor generator has been in operation for *at least 30 seconds.* **Start the PU–20A/C motor by pressing the START button.**

8. Control Box

The function of * * * the motor generator. The rheostat is used to control the amount of current being fed from the d-c generator to the field of the alternator, thus increasing or decreasing the a-c output voltage. A-c and d-c * * * for 400-cycle operation.

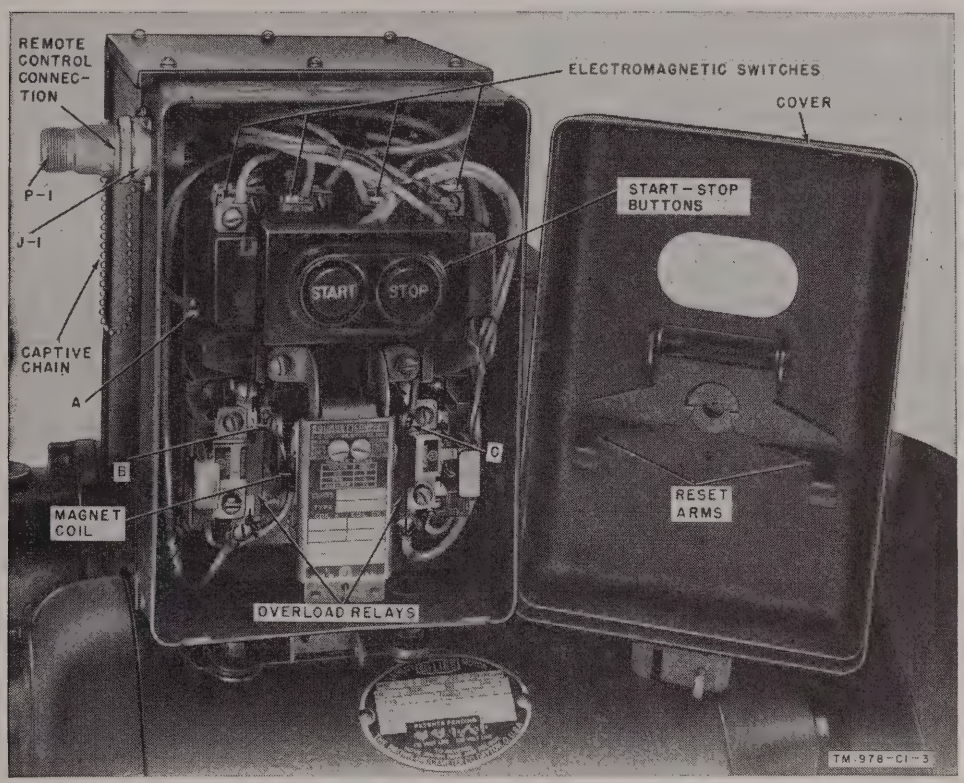


Figure 1.3. (Added.) *Electromagnetic switch box (PU–20A/C).*

To stop the motor, press the STOP button. If motor fails to start when the START button is pressed, press the RESET button and then press the START button.

* * * * *

6. Motor

The motive power for Motor Generator PU–20/C is a conventional, 115/230-volt, single-phase, 60-cycle, 1,800 rpm **(1,750 rpm on the PU–20A/C)** electric motor.

8.1 (Added.) Motor Control Unit (PU–20A/C only)

The motor control unit starts and stops the motor, automatically stops the motor in event of overload, permits the operation of the motor on either 110 or 220 volts, and provides for motor starting and stopping from a remote point.

a. Electromagnetic Switch (fig. 1.4). The four electromagnetic motor switches, which normally are open, are actuated by a large magnet the coil of which is fed from the 110-volt secondary of the transformer (201). When the START button is pressed, the transformer secondary current is caused to flow through the large magnet coil which

then becomes energized. The resulting intense magnetic field pulls on the armatures which actuate the electromagnetic motor switches. Another armature actuates a holding switch which is in series with the transformer secondary circuit. The holding switch closes the transformer secondary circuit and keeps it closed even when the START button is released. When the STOP button is pressed, the transformer secondary circuit is opened and thus cuts off the current supply to the magnet coil of the electromagnet. The armatures, now de-energized, are pulled back by spring action and the five circuits are opened. The motor stops.

b. Overload Relay. The contacts on the two overload relays (switches) are in series with the transformer secondary circuit and normally are closed. Current, feeding the magnet coil of the electromagnet, is shut off when the overload switch coils, which are in series with the motor windings, are subjected to an excessive current flow. During overload, both overload-switch armatures are pulled against spring tension and cause the series contacts to open. Since the current to the electromagnetic switch field coil is shut off, the magnetic field collapses and all four motor switches open, shutting off the current through the motor coils. Both overload-switch armatures are placed back into operating position by the RESET button which is depressed by the operator after the cause of the overload is removed.

c. Remote Control. When the START button of the remote push button assembly is pressed, pins 2 and 3 are connected to pin 1 of the remote male connector P–2. Since connector P–2 is plugged into receptacle J–1 when remote operation is desired, contact 1 of receptacle J–1 is connected to contacts 2 and 3 (J–1), thus completing the circuit of the transformer secondary through the magnet coil, causing the five armatures to force their contacts against their mating contacts and feed line voltage to the electric motor. Pressing the STOP button of the remote control push-button assembly causes the circuit to the magnet coil to open and the magnetic field to collapse. The four motor switches and the holding switch are pulled open by spring tension, thus shutting off the electric motor.

d. Transformer.

(1) *For 220-volt operation.* Transformer 201 has two primary windings and one secondary winding. By placing the link on studs 3 and 2, operation of the motor generator on 220 volts is made possible. With the link in this position, the two trans-

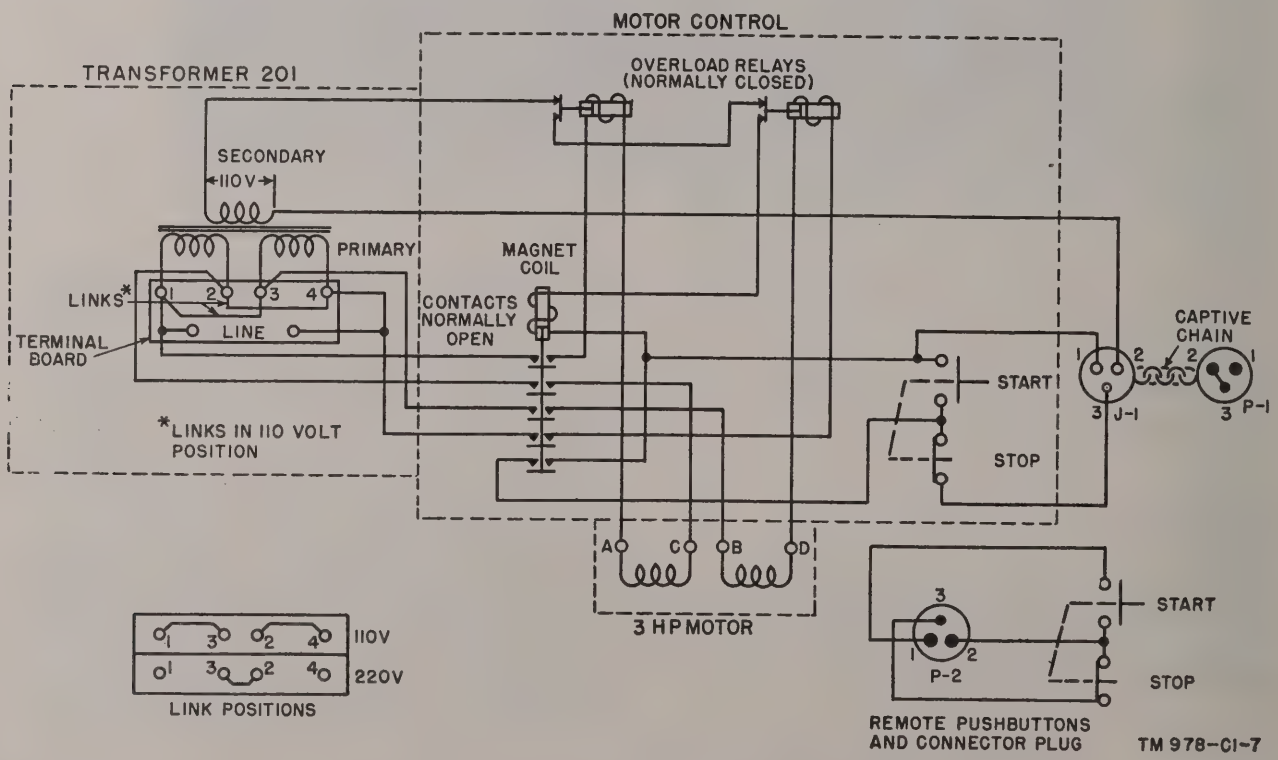


Figure 1.4. (Added.) Simplified diagram of motor control unit (PU–20A/C).

former primaries are connected in series with 220 volts across them. Also, in this link position, the two motor windings are connected in series, thus permitting the 220-volt line to flow through both windings. One half of the line voltage appears across each motor coil.

(2) *For 110-volt operation.* With studs 1 and 3 connected together, and 2 and 4 connected together, operation on 110 volts is made possible. In this link position, the two transformer primaries are in parallel and 110 volts appear across each primary winding. Also, in this link position, the two motor windings are so connected that the 110-volt line appears across each coil. The transformer secondary voltage is the same (110 volts) in either link position since the primary to secondary ratio is correct for the primary voltage used. The secondary voltage is used to energize the magnet coil which supplies the magnetism required to close the four motor switches and one holding switch.

12. Lubrication

a. MOTOR (PU–20/C ONLY). After every 512 * * * motor as follows:

* * * * *

(7) Using a dry, * * * the motor housing.

Note (added). Sealed bearings are used on the PU–20A/C motor and additional lubrication is not required.

* * * * *

13. Motor Bearing Washing Procedure (PU–20/C only)

* * * * *

18. Preventive Maintenance Schedule

The following table * * * time intervals shown.

Job to be done	Every 8 hours	Every 64 hours	Every 200 hours	Every 512 hours	Every 1,024 hours
•	•	•		•	•

Note (added). The PU–20A/C motor bearings do not require preventive maintenance.

19. Moistureproofing and Fungiproofing

Note (added). Motor Generator PU–20A/C is shipped moistureproofed and fungiproofed. If the varnish film is broken because of parts replacement or other reasons, apply the varnish-spray method to the affected parts as described in TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment. If the control box or spark wheel, or both, are to be treated, follow the instructions given below.

* * * * *

20. Motor Generator Trouble Chart

Trouble	*Possible cause*
a. Motor fails to start or is up to speed.	(1) Low voltage of power supply.
	* * *
	(3) Failure to press RESET button.
	(4) Connector plug P–1 not inserted in remote connector J–1.
	(5) Defective wiring to remote control pushbutton assembly.
	(6) Defective electromagnetic switch.
	(7) Links not properly or loosely connected.
	(8) Defective transformer.
* *	* * *
e. Radio reception is noisy.	(1) Defective capacitor on brush head.
	* * *
	(7) Defective capacitor C–5 in generator shell.

21. Disassembly of Motor Generator

* * * * *

d. (Added.) REMOVING MOTOR CONTROL UNIT.

(1) Disconnect line leads from the studs marked LINE. Make sure the line is disconnected from the leads before touching the studs.

(2) Disconnect the motor leads from the small terminal box on the side of the motor and disconnect the flexible conduit.

(3) Remove the four screws from the terminal box and remove the box from the top of the motor.

Note. Do not disassemble the PU–20A/C motor. Return defective motor to repair depot for repair or replacement.

* * * * *

22. Generator Testing (A–C and D–C)

e. (Added.) Motor Control Unit (PU–20A/C).

(1) *Transformer testing.*

(*a*) Open the power line circuit.

(*b*) Remove the terminal box cover.

(*c*) Disconnect line leads from LINE terminals and links from transformer terminals.

(*d*) Apply ohmmeter test prods to terminals 1 and 2. Normal resistance is 19 ohms.

(*e*) Apply leads to terminals 3 and 4. Normal resistance is 19 ohms. If the ohmmeter indication is approximately 19 ohms on both tests, the transformer primary windings are continuous and probably normal.

(*f*) Remove the cover from the electromagnetic switch box and apply the test prods to terminals A and B (fig. 1.3). Normal resistance is 14 ohms. If the ohmmeter indication is approximately 14 ohms, the transformer secondary is continuous and probably normal. Check for signs of overheating.

(2) *Electromagnetic switch testing.*

(*a*) Apply ohmmeter test prods to terminals B and C (fig. 1.3). Normal resistance is 16 ohms. If ohmmeter indication is approximately 16 ohms, the magnet coil is continuous and probably normal.

(*b*) If the electromagnetic switch jams, or is intermittent in operation, check for free travel of armature and secure all terminal connections.

Figure 14. ***Generator*** *wiring diagram (PU–20/C).*

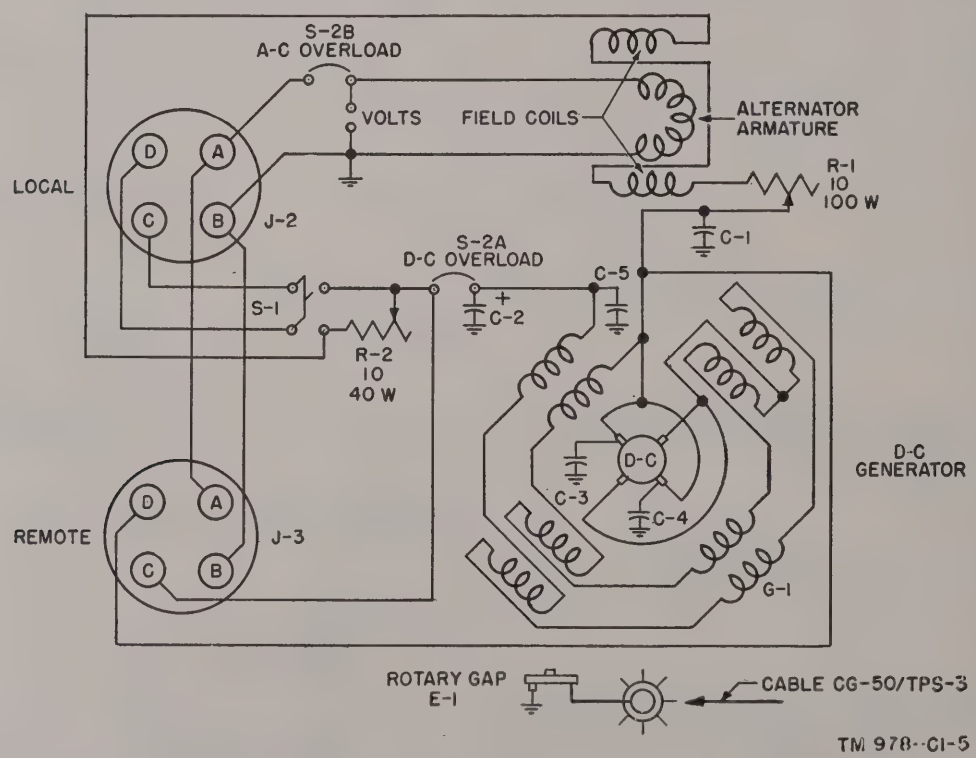


Figure 14.1. (Added.) *Generator wiring diagram (PU–20A/C).*

Figure 15. Practical wiring diagram (PU–20/C).

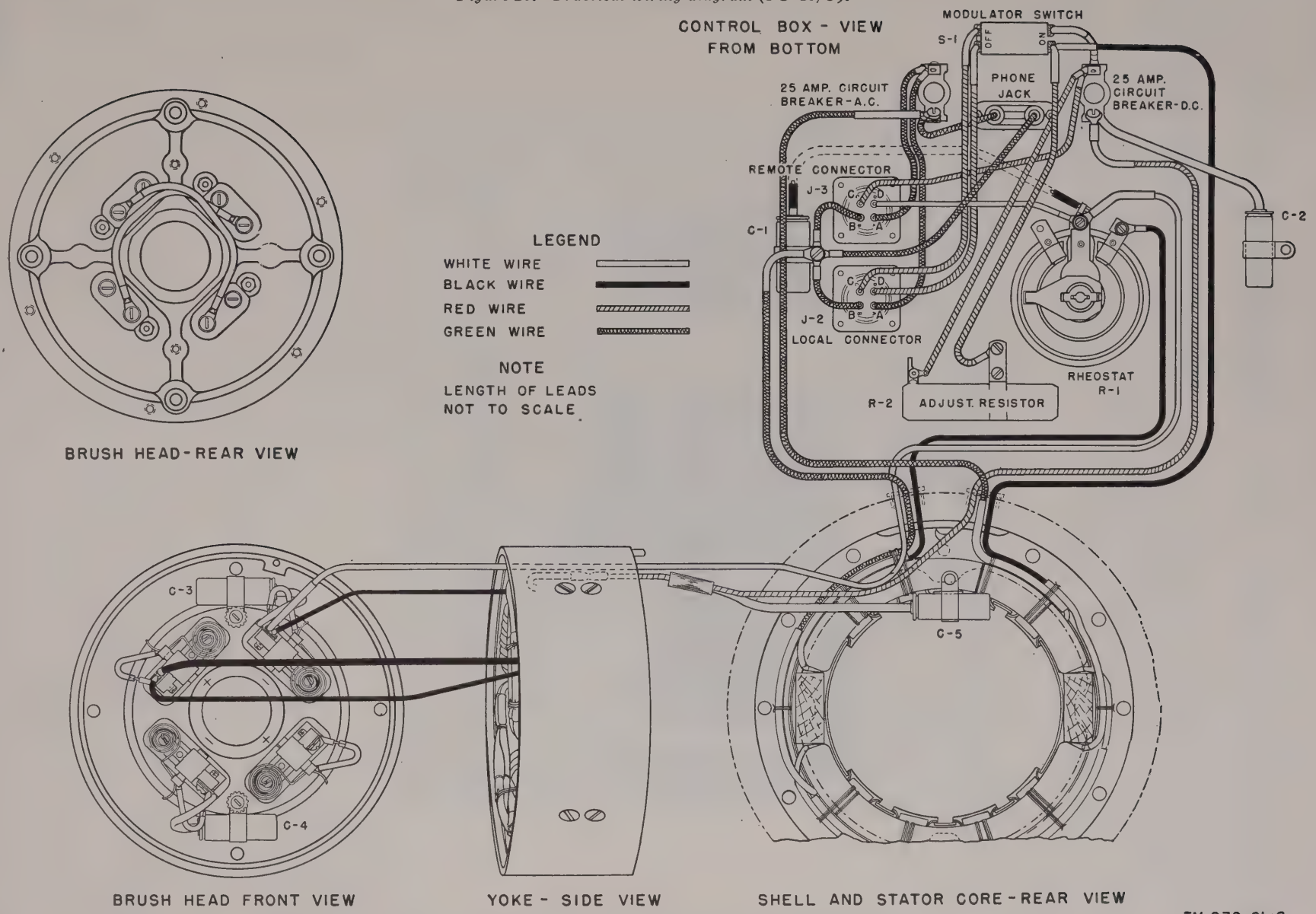


Figure 15.1. (Added.) *Practical wiring diagram (PU–20A/C).*

23. Assembly of Motor Generator

* * * * *

c. Generator Assembly

* * * * *

(2) If the yoke * * * four yoke bolts. *Refer to wiring diagrams* (*figs. 14*, ***14.1,*** 15, **and 15.1**) *to make sure that all connections are correct.* Slide the complete * * * and lockwashers (fig. 9).

* * * * *

Key to reference numbers in figure 17.

159 Brush jumper

* * *

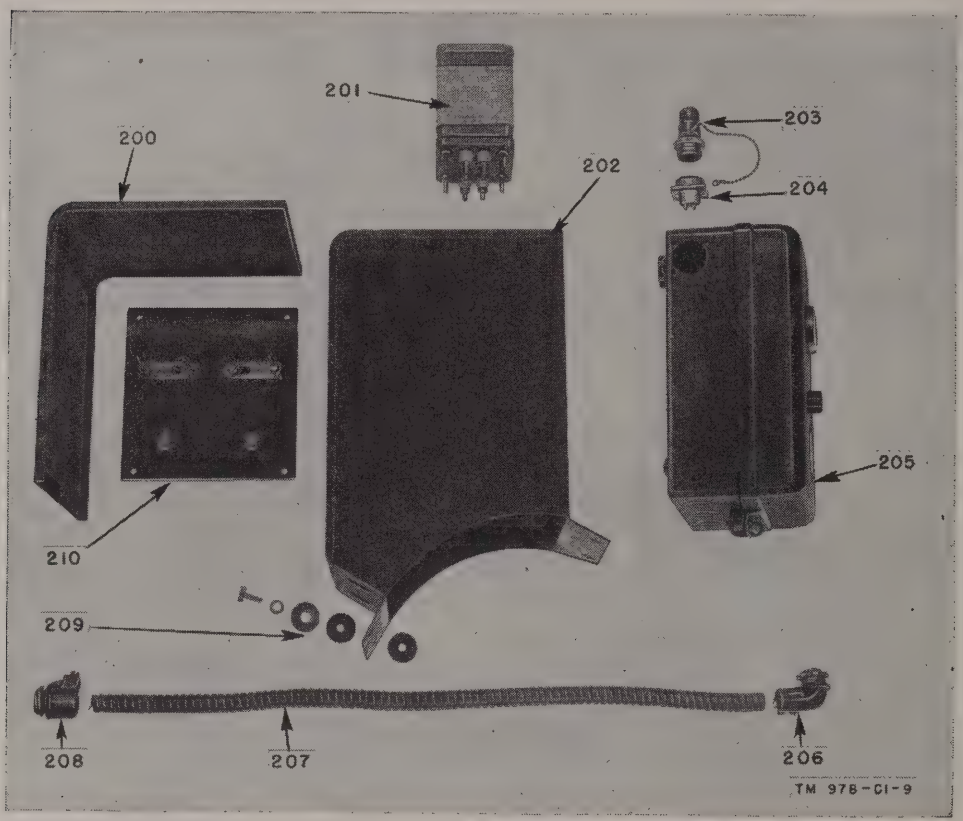
166–1 Capacitor **(On the PU–20A/C, this capacitor has a detachable lead.)**

* * *

Key to reference numbers in figure 19.

166–2 Capacitor **(On the PU–20A/C, this capacitor has a detachable lead.)**

* * *



200 Terminal box cover
201 Transformer
202 Terminal box
203 Local connector and chain (P–1)
204 Female connector (J–1)
205 Electromagnetic switch box
206 Fitting (90°—elbow)
207 Flexible conduit
208 Conduit fitting
209 Rubber washer
210 Terminal board

Figure 20. (Added.) *Motor control unit parts* (*PU–20A/C*).

24. (Superseded.) Identification Table of Parts for Motor Generators PU–20C and PU–20A/C

Note. The fact that an item appears in this technical manual is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O & E, T/A, T/BA, SIG 6, SIG 7 & 8, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1.

Identification Table of Parts

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
Fig. 1.1	MOTOR GENERATOR PU–20A/C: dual output 120 v AC 11.7 amp, 1400 w, 90% pf, 400 cyc, single ph, 2 wire AC; 28 v, 14.3 amp, 400 w, DC; input 115/230 v, 20/40 amp, 60 cyc, single ph, 2 wire AC; gen speed 4000 rpm, motor speed 1750 rpm; HL dwg #M13A120D28–14; 35.0″ x 28.0″ x 23½″ overall; incl motor and gen control units and protective devices; Sig C tentative spec #71–3279.	Generates electricity at rated output.	3H3370–20.
Fig. 1	MOTOR GENERATOR PU–20/C; same as above except that motor is of different manufacture and its rpm is 1800.	Same function as above	3H3370–20.
	GENERATOR GROUP		
Fig. 10	ARMATURE, D-C, generator: baked varnish finish; 28 v, 14.3 amp; 12$^{3}/_{16}$″ lg x 4.020″–4.018″ OD overall; keyed on shaft one end, brg mtd other end, bolted to shaft; HL part #AA–60213–1.	Generates dc	
Fig. 11 (127)	BEARING, ball: single row radial; double shield; med duty; 0.7874″ bore, 2.0472″ OD, 0.5906″ wd; 7 balls; pkd w/std slush type grease; std fit; ABEC–1, std tol; ND 77604, spec XiE.	Provides antifriction support for generator countershaft.	3H305–84.
Fig. 12 (123)	BEARING, ball: single row radial; double shield; light duty; bore 30 mm, 1.811″, OD 62 mm, 2.4409″, wd 16 mm, 0.6299″; 9 balls, ⅜″ diam; pkd w/std slush type grease; std fit; ABEC–1 std tol; ND #77506.	Provides antifriction support for countershaft.	3H320–13.
Fig. 16 (150)	BEARING, ball: single row radial; double shield; light duty; bore 0.6693″, OD 1.5748″, wd 0.4724″; 8 balls, ¼″ diam; pkd w/std slush type grease; std fit; ABEC–1 std tol; ND #77503.	Provides antifriction support for armature and rotor assembly.	3H2342B/B2.
Fig. 2	BELT, V: rubber comp; $^{11}/_{32}$″ wd inside x ½″ wd outside, ½″ d outside, outside circum 48.2″; matched pair, B type; Allis-Chal #AC–A–46.	Transmits rotary power from motor to generator.	3H2405–1/B7.
Fig. 18 (177)	BRUSH, electrical contact: carbon; 2⅛″ lg x $^{5}/_{16}$″ wd x $^{5}/_{16}$″ thk overall; sq oblong; flat cont surface; incl pressure spring and shunt; HL part/dwg AA–711.	Grounds spark wheel assembly.	3H2422/B31.
Fig. 17 (165)	BRUSH, electrical contact: carbon, grade CM–9, Morganite; 3$^{7}/_{16}$″ lg x ¾″ wd x ¼″ thk overall; rectangular; concave cont surface; w/pigtail; HL part/dwg #25198–1.	Collects dc from generator commutator.	3H2422/B30.
Fig. 18 (172)	CHUCK: electrode, brass; ¾″ lg x ⅜″ wd overall; screws in pothead; HL part/dwg #25554.	Holds electrode in proper position.	3H2422/C20.
Fig. 16 (139)	COLLET: screw type; brass, nickel pl; ⅝″ lg x $^{7}/_{16}$″ wd overall; HL part/dwg #25492.	Holds electrode in spark wheel.	3H1916/S12.
Fig. 16 (137)	ELECTRODE, tungsten: spark wheel; tungsten steel; 1⅝″ lg x 0.080″ diam overall; HL part/dwg #25495.	Provides ground side of spark gap.	3H1916/E25.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	GENERATOR GROUP—Continued		
Fig. 1	GENERATOR, AC-DC: dual output, 1400 w AC, 90% pf, 400 w DC, 4000 rpm; 120 v AC; 400 cyc, 1 ph, 2 wire; 28 v DC, 2 wire; open frame, 4 pole; 55°C temp rise; 24″ lg x 12¼″ wd x 15¼″ h; 1″ diam shaft extends 4″; incl 2 pulleys; 2 groove V pulley, 10.0″ OD x 2 3⁄32″ thk overall; incl control unit w/rheostat, adj resistor, circuit breakers (2), phone jack, mod switch, 4 pole output receptacles (2), fixed capacitor; four 5⁄16″ diam mtg holes on 7¼″ x 10¾″ mtg/c; HL part/dwg #A–31376.	Generates rated output of ac and dc.	3H2422.
Fig. 16 (141)	NUT, collet: hex; brass, nickel pl; ¼″–20 thd; ¾″ h; ½″ wd across flats; HL part/dwg #81052.	Secures collet screw and electrode to spark wheel.	3H1916/N20.
Fig. 18 (173)	NUT, hexagon: brass; ¼″–20 thd; ¼″ h; 11⁄32″ wd across flats; HL part/dwg #25553.	Acts as chuck nut to secure H. V. electrode in pothead assembly.	3H2422/N10.
Fig. 16 (138)	PLATE, brush: for grd brush; copper; cir disk; 1¾″ diam x 3⁄32″ thk overall; 3 mtg holes 0.149″ diam, equally spaced; HL part/dwg #25491.	Provides grounded surface for ground brush.	3H1916/P16.
Fig. 12 (121)	PULLEY (SHEAVE): generator driven; 2 groove type; texsteel; 4¾″ OD x 2 23⁄32″ thk overall; 1.0″ diam through entire bore; ⅝″ wd ⅝″ d ea groove; ¼″ wd x ⅛″ d keyway; Allis-Chal TH–36005.	Enables use of power-carrying belts in step-up ratio.	3H4600P1–3.
Fig. 16 (148)	WINDING, generator field: baked varnish finish; 28 v; bore 1⅛″ x 2⅞″ lg x 1 7⁄32″ thk; mtd on pole piece; HL part #AA–31386.	Creates magnetic field	
	MOTOR GROUP		
	BEARING, ball: single row radial; double shield; light duty; bore 30 mm, 1.811″ OD 62 mm, 2.4409″, wd 16 mm, 0.6299″; 9 balls; pkd w/std slush type grease; std fit; ABEC–1 std tol; ND #77506.	Provides antifriction support for motor armature.	3H320–13.
	MOTOR, AC: repulsion cond type; 3 hp, 1750 rpm; open frame; 40° temp rise; w/o pulley, keyed shaft, ¼″ wd x ⅛″ d keyway; 16.0″ lg x 13.0″ wd x 11.0″ h, 1.0″ diam shaft extends 3½″; 115/230 v AC, 60 cyc, single ph, 20/40 amp, 90% pf; Brown-Brock, frame #225; fixed mtg base; 4 slotted 13⁄32″ wd holes, 7½″ x 9.0″ mtg/c; incl control unit; Brown-Brock type RM, MS–246B, ES–6013; HL part/dwg #30964–3 (PU–20A/C only).	Provides rotary power to drive generator.	
Fig. 1	MOTOR, AC: 3 hp; 115/230 vac; single phase; 16800 rpm; GE model 5KC225H2; WC–225 frame; (open ball bearings; windings specially treated to meet Signal Corps spec 71–2202–A dated April 1944; HL #25564.)	Same as above	3H3003–3.
Fig. 12 (132)	PULLEY (SHEAVE): motor drive; 2 groove type; texsteel; 10.0″ OD x 2 21⁄32″ thk; 1.0″ diam bore; 2 grooves ⅝″ wd x ⅝″ d; ¼″ wd x ⅛″ d keyway w/2 cap point screws; Allis-Chal TH–36021.	Enables use of power-carrying belts in step-up ratio.	3H4600P1–2.
	WINDING, motor field: baked varnish finish; 115/230 v, 36/16 amp, 3 hp; 10¼″ OD x 6.0″ ID x 6.0″ lg overall; Brown-Brock #ES6360.	Provides required magnetic field.	

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	MOTOR AND GENERATOR CONTROL GROUP		
Fig. 19 (187), S–2A, S–2B.	CIRCUIT BREAKER: thermal; single pole, double break; 120 v AC, 25 amp; bakelite case; 1⅜″ lg x ⅞″ wd x ¾″ d overall; time delay 4 sec at 100% overload; manual reset; neck mtd type, mts in ½″ diam panel hole w/washer and hex nut; incl two #8–32 x ¼″ terminal screws; p/o gen control unit; Spencer Thermo #PSM–25.	Opens circuit upon overload in generators.	3H900–25–13.
Fig. 1.4, J–1 (204)	CONNECTOR, receptacle: 3 round female cont, polarized; straight type; 1 27/32″ x 1 27/32″ overall; cyl body w/sq flange, aluminum, sprayed w/moisture and fungus resistant lacquer; thd for locking ring of male connector; molded phenolic insert, fungus lacquer finish; ⅝″ cable opening; mts w/4 screws and nuts, 1.0″ ctr holes in flange; Cannonelec part #RWK–C–3–31SL type RWK (PU–20A/C only).	Provides for local or remote control of motor.	2Z8673.46.
Fig. 1.4, P–1, P–2 (203).	CONNECTOR, plug: 3 round cont male polarized; straight type; 2 1/32″ lg x ⅝″ OD overall; cyl body, aluminum, fungus lacquer finish; thd locking ring; molded phenolic insert, fungus lacquer finish; 7/16″ ID cable opening; soldered to leads and clamped; incl chain; Cannonelac part #WK–C3–21–1/2AN, type WK (PU–20A/C only).	Provides for local or remote control of motor.	
Fig. 19 (184), J–3, J–4.	CONNECTOR, receptacle: 4 round female cont, polarized; straight type; 1 11/32″ x 1 11/32″ overall; round body, sq flange, aluminum, natural-finish, locking type; 1.0″ cable opening; screw mtd, 4 thd holes in flange #6–32; AN–3102–20–4S.	Provides for remote or local operation of using equipment.	
Fig. 19 (183), R–2.	RESISTOR, adjustable: WW; 5 ohms ±10%; 40 w; 1 slide; 3½″ lg x ⅛″ wd x ¾″ d overall; vitreous E, ceramic core; 1 adj screw term #8–32 x ⅜″, 1 fixed screw term #6–32 x ⅝″; mtg 2 ctr washers, Fil H screw, lockwasher, hex nut; WL type B.	Limits alternator field current.	3Z4805–9.
Fig. 19 (181)----	RESISTOR, variable: WW; 10 ohm +10%; metal case; 1.78″ d x 3.78″ diam overall incl terms; open case; flatted metal shaft ¼″ diam x 2½″ lg; w/o off position; bushing mtd, ⅜″–32 x ⅜″ lg w/nonturn device located on ½″ radius; JAN type #RP125FK–100KK.	Controls alternator field current to increase or decrease a-c output.	3Z7010–10.
Fig. 19 (186) S–1-	SWITCH, toggle: DPST; 6 amp, 250 v; 12 amp, 125 v; bakelite case; 1¾″ lg ⅞″ wd x ⅝″ d overall; bat type handle, ½″ lg; locking action, normally open; 4 binding screw term; mts w/hex nut; AH&H #1350.	Connects a-c and d-c output to LOCAL connector (MODULATOR switch).	3Z9508.
Fig. 1.3---------	SWITCH, electromagnetic: sheet steel case, primed and painted to spec; 115/230 v AC, 60 cyc, single ph, 20/40 amp; 6¼″ lg x 5.0″ wd x 9½″ h overall; four ¼″ diam holes 4⅝″ x 6⅝″ mtg ctr, mts on term box; sq D modified by HL part/dwg #AA30965–3 (PU–20A/C only).	Starts, stops, and protects electric motor from overload damage.	
Fig. 1.2---------	TRANSFORMER, power: isolation type; input 115/230 v, 60 cyc, single ph, 4 wire, 50 va; output 115 v, 2 wire, 1 output winding; 1 output winding, 115 v, 0.435 amp w/2 wire taps; potted metal case, non herm sealed; 3¼″ lg x 2¾″ wd x 4.0″ h overall; four #10–24 thd x ½″ studs on 2.0″ x 2⅛″ mtg ctr; Raytheon type M–11643–1; JAN–T–27, grade 3, class A (PU–20A/C only).	Supplies current to operate overload relays and electromagnetic motor switches.	

Identification Table of Parts—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	SUPPRESSION GROUP		
C–1, C–2, C–3, C–4, C–5.	CAPACITOR, fixed: Sig C Capacitor CA–444; paper dielectric; 1 sect; 0.10 mf; 100 vdcu; herm sealed metal can; 1 1/16" lg x 5/8" diam; oil impr; 1 screw term at end; U. S. Army spec #71–1667, SC–D–8669; Ord #502025.	All capacitors used to suppress r-f radiations from motor generator.	3D444.

[AQ 300.7 (29 Mar 49)]

By order of the Acting Secretary of the Army:

Official:
EDWARD F. WITSELL
Major General
The Adjutant General

OMAR N. BRADLEY
Chief of Staff, United States Army

Distribution:
Army:
Tech Sv (2); Arm & Sv Bd (1); AFF Bd (ea Sv Test Sec) (1); AFF (5); OS Maj Comd (5); Base Comd (3); MDW (5); A (ZI) (20), (Overseas) (5); CHQ (2); FC (2); USMA (2); Sch 11 (10); Gen Dep (10); Dep 11 (5) except Baltimore & Sacramento (20); Tng Ctr (2); PE (10); OSD (2); Lab 11 (2); 4th & 5th Ech Maint Shops 11 (2); T/O & E 11–47 (2); 11–107 (2); 11–127 (2); 11–587 (2); 11–592 (2); 11–597 (2); SPECIAL DISTRIBUTION.
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